WEST VIRGINIA
GEOLOGICAL SURVEY

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PLATE I.—Looking east down valley of North Fork of South Branch of Potomac River from western end of North Fork Gap. Cliff on right is White Medina Sandstone in north end of North Fork Mountain. Cliff on left is the same (300 feet thick) in south end of New Creek Mountain. Cliff in background is Oriskany Sandstone. Rock in immediate foreground is White Medina showing characteristic black fungus growth. Topography ranges from Oriskany to Martinsburg Shale.

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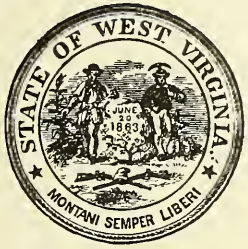

Mineral and Grant Counties

By

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Assisted in Office by
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I. C. WHITE, State Geologist
1924.

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LETTER OF TRANSMITTAL

To His Excellency, Hon. E. F. Morgan, Governor of West Virginia, and President of the West Virginia Geological Survey Commission:

SIR:

I have the honor to transmit herewith the Detailed Geologic Report and Soil, Topographic, and Geologic Maps covering the Counties of Grant and Mineral, prepared by Mr. D. B. Reger, Assistant Geologist, aided by R. C. Tucker, Dr. Jno. L. Tilton, Dr. Wm. F. Prouty, and others. Like all of Mr. Reger's reports this one is no exception in revealing the results of careful, thorough, and conscientious investigations. The areas treated in this volume present in the upturned edges of the stratified rocks a succession of beds extending from the base of the Monongahela Series of the Coal Measures down through a long list of geologic formations, and 200 to 300 feet into the Martinsburg Shale at the top of the Ordovician, having a total maximum thickness of approximately 3½ miles of strata. This long column of rocks was studied in Mineral County in 1880 by the writer, measured, classified, and correlated with the several geologic formations previously described by the New York Geological Survey, and published in 1881 in the Proceedings of the American Philosophical Society of Philadelphia, Pa.*

This long detailed section which is republished by Mr. Reger on pages 142-150 of this volume was the first attempt to correlate the Devonian and Silurian strata of West Virginia with the same subdivisions established in New York by Hall, Emmons, Mather, and others 40 odd years before. When the young geologists of the United States Geological Survey came into West Virginia to study its geologic formation, 30 odd years ago, they did not take the trouble to give serious thought to the correlation problem, but instead adopted a classification of their own based entirely on the local geology to which they gave new names, like Romney, Hampshire, Tuscarora, etc., etc., some of which the Maryland Geological Survey in defiance of all the well-established laws of nomenclature has adopted. The West Vir-

*Notes on the Geology of West Virginia. A recapitulation of the section made by Mr. Howard Grant Jones on the Cumberland or Potomac Coal Basin. American Philosophical Society, 1881.

ginia Geological Survey believes in perpetuating the old and well-established geologic nomenclature long ago so well defined and described for the larger subdivisions of the Devonian and Silurian beds in New York, since so many of them have been certainly identified by the writer in West Virginia as well as in Pennsylvania, not only by their stratigraphic and lithologic succession but also from their fossil contents. Hence, in the West Virginia Geological Survey Reports, the New York nomenclature will be used in our geologic classification so far as it is applicable to the facts, new names being introduced only to express a more detailed differentiation of the several classic formations first studied and given geographic names in the State of New York. The drastic revision of identifications and correlations in the Coal Measure stratigraphy brought about largely through the classic work of Dr. Swartz and his assistants of the Maryland Geological Survey is approved and confirmed in its main features by the subsequent studies of Mr. Reger embodied in this Report. This revision is concurred in by none more heartily than the writer who in the absence of topographic maps, levels, etc., was originally responsible for many of these correlation errors embodied in Volumes II and II(A) of the West Virginia Geological Survey, the same being further perpetuated by the early publications of the Maryland Geological Survey. The first or preliminary geological publication in most every new geologic province usually contains some unavoidable errors of correlation and yet if publication was withheld until all sources of error could be eliminated, geologic work would be almost futile. Hence, the better plan appears to be to publish promptly what seems to be the truth, and then if error has been committed subsequent observers will detect and correct them all the sooner.

Very respectfully,

I. C. WHITE
State Geologist.

Morgantown, W. Va.
September 1, 1924.

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AUTHOR'S PREFACE

This book is a general geological report on Mineral and Grant Counties, West Virginia. As shown by the Table of Contents, it contains a short chapter of Historical and Industrial data, a chapter on Physiography, thirteen chapters on Geologic History, Structure, and Stratigraphy, five chapters on Mineral Resources, and a chapter on Paleontology, as well as an Appendix giving all available spirit-level bench marks and railroad levels in the two counties.

In a separate Atlas, Map I shows the topography of Mineral County and Map III shows that of Grant, these being assembled and photolithographed from the standard topographic quadrangles as surveyed and published by the United States Geological Survey in cooperation with the West Virginia Geological Survey, certain additions and corrections, principally railroads and place names, being added by the author. In the same Atlas, Map II, which is made from the base mentioned, shows the General and Economic Geology of Mineral County, and Map IV shows the same data for Grant.

In the region west of the Allegheny Front, where the principal remaining natural resource is coal, a careful and painstaking study of the strata was made in order to determine, if possible, the true relationships and correlations of the various beds. As explained in the text and as previously discussed by the writer in the Tucker County Report, it has been known for several years that improper titles have been used for nearly all the minable coals below the Pittsburgh seam, the mistakes made by early investigators having been due to the serious and overwhelming handicaps under which they worked. The accumulated data of the present time, however, including new railroad and highway cuts, prospects, mines, and diamond-drill holes, have much simplified the problem of correlation so that the information is now fairly conclusive.

In presenting the necessarily radical changes in the nomenclature of the coals, with the attendant confusion in trade usages, the action is considered as regrettable but altogether unavoidable and already too long delayed. A special attempt has been

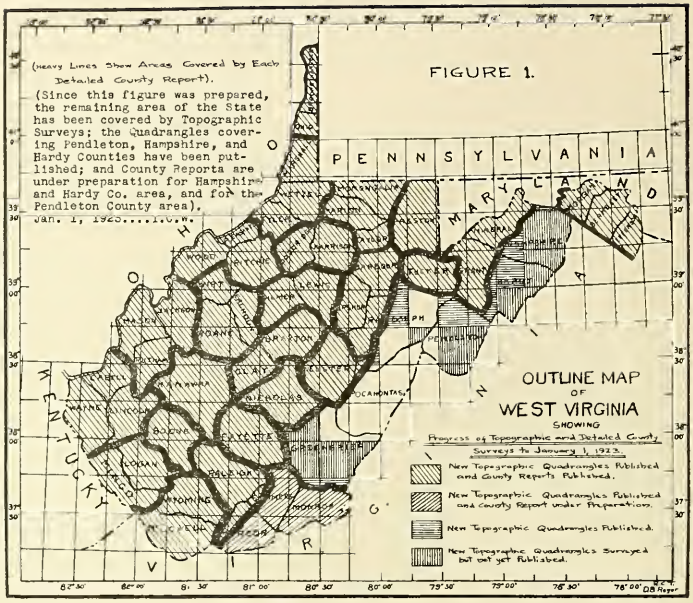
FIGURE 1.
(Heavy Lines Show Areas Covered by Each Detailed County Report).
(Since this figure was prepared, the remaining area of the State has been covered by Topographic Surveys; the Quadrangles covering Pendleton, Hampshire, and Hardy Counties have been published; and County Reports are under preparation for Hampshire and Hardy Co. Area, and for the Pendleton County area).
Jan. 1, 1923....J.V.W.
PENNSYLVANIA
MARYLAND
OHIO
KENTUCKY
VIRGINIA
OUTLINE MAP
OF
WEST VIRGINIA
SHOWING
Progress of Topographic and Detailed County Surveys to January 1, 1923.
New Topographic Quadrangles Published and County Reports Published.
New Topographic Quadrangles Published and County Report under Preparation.
New Topographic Quadrangles Published.
New Topographic Quadrangles Surveyed but not yet Published.

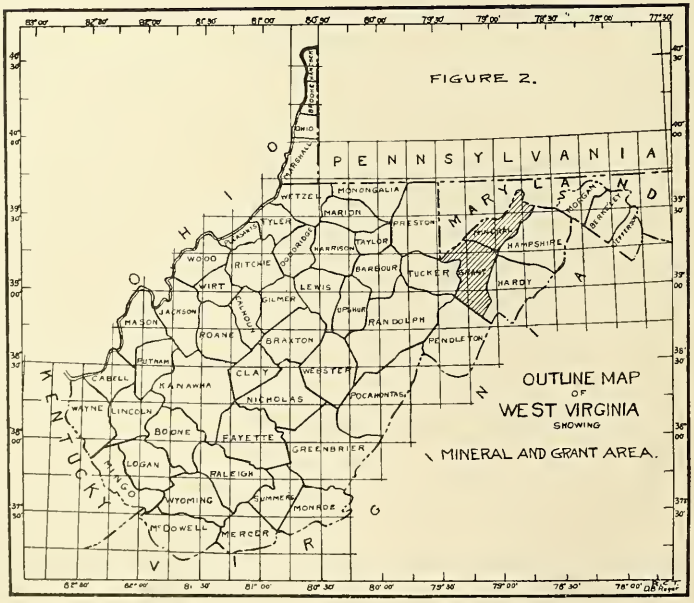
FIGURE 2.
PENNSYLVANIA
MARYLAND
OHIO
KENTUCKY
VIRGINIA
OUTLINE MAP
OF
WEST VIRGINIA
SHOWING
MINERAL AND GRANT AREA.

made to show clearly in each case the former names which have been attached to the coals so that the transition of titles will be plain. Most of these changes have already been verbally announced to many of the operators in the Potomac Valley through discussions on the ground where the evidence was in full view. The active and altogether unusual interest taken on their part as the investigation went forward leads to the belief that the general acceptance of the revisions will soon take place.

In the region east of the Allegheny Front, where the outcropping rocks are principally Devonian and Silurian, the attempt was made to determine and fix as firmly as possible the relationship and correlation of the various formations with reference to the same beds in New York State and eastern Pennsylvania which are the classic American localities of most of these sediments, the necessity for such action being evident because of the fact that the study of these beds southwestward across West Virginia hinges largely on Mineral and Grant Counties. With this end in view local titles employed in comparatively recent publications which have bearing on the region have been rigorously discarded, the lithological and faunal similarity with eastern prototypes being in most instances fairly conclusive.

The attention of the cement and limestone trade is called to Chapter XVIII which is especially devoted to this industry and in which the possibilities of the two counties are described.

The author spent the field season of 1921 in gathering data for this Report, the publication of which has been delayed because of other unavoidable duties and because of an illness which lasted for many weeks. Help of a most valuable character was obtained from Dr. John L. Tilton, Paleontologist, who identified the fossil collections of the writer, and from Dr. Wm. F. Prouty, Paleontologist, who examined those made by Prof. Earl R. Scheffel of the Geological Department of the University of West Virginia, and by Mr. Paul H. Price during the summer vacation period of 1922.

The special attention of vertebrate paleontologists is called to the reptilian tracks near Piedmont, described in Chapter XXI in a paper by Dr. R. S. Lull, of Yale University, who made a trip to the locality to investigate them in person.

Valuable office assistance was rendered by Mr. R. C. Tucker, of the Survey Staff, who prepared much of the statistical matter, duly credited in the text, made the final draft of the maps and figures, prepared the Index, and proof-read much of the manuscript. Acknowledgment is also made of the work of Mrs. George R. Farmer who assisted in the compilation and transcription of data and of Marie Stenger Azure who copied the manuscript. Assistance in preparation of the Index was also rendered by Paul H. Price.

The chemical and calorific tests, except as otherwise specified in the text, were made by B. B. Kaplan, Chemist of the Survey, whose ability as a chemist is well established.

Among parties living within or otherwise interested in the territory of the Report, special acknowledgment is made to the Davis Coal and Coke Company, which through its Chief Engineer, Mr. S. B. Jeffries, and other members of its technical force, furnished the records of many coal test borings and other valuable data; to the Brady Coal Corporation for core tests and other data furnished through its President, Mr. Samuel D. Brady; to the Dodson Bituminous Coal Corporation for maps and other data through its President, Mr. Truman M. Dodson; to W. D. Althouse & Co. for core tests supplied by Mr. W. D. Althouse; to the West Virginia Pulp and Paper Company for core tests furnished by Mr. Allen Luke; and to the Potomac Oil and Gas Corporation for well records furnished by Mr. William Hickman. It is manifestly impossible to make detailed mention of the many Mineral and Grant County citizens who most generously furnished local guidance, often at personal inconvenience to themselves, but to all of these general acknowledgment is made both on behalf of the author and in the name of the State whose interest was served.

Finally, the author expresses his obligation to Dr. I. C. White, State Geologist, whose constant supervision, most kindly criticisms, and instructive suggestions have added greatly to the value of this Report.

DAVID B. REGER.

Morgantown, W. Va.,
October 19, 1923.

ERRATA.

Page 221, line 9 from bottom, for **"Ischilina,"** read **"Isochilina."**
Page 233, line 5 from top, for **"Pennsylvania,"** read **"Pennsylvanian."**
Page 304, line 18 from top, for **"Liorynchus,"** read **"Liorhynchus."**
Page 307, line 21 from bottom, for **"spatula,"** read **"spatulata."**
Page 307, line 14 from bottom, for **"Liorynchus,"** read **"Liorhynchus."**
Page 311, line 16 from bottom, for **"Platystoma,"** read **"Platyostoma."**
Page 317, line 19 from bottom, for **"Liorynchus,"** read **"Liorhynchus."**
Page 318, top line, for **"Anoplea."** read **"Anoplia."**
Page 318, line 4 from top, for **"Crytolites,"** read **"Cyrtolites."**
Page 318, lines 9, 10, and 11 from top, for **"Liorynchus,"** read **"Liorhynchus."**
Page 318, line 24 from bottom, for **"Proteus,"** read **"Proetus."**
Page 322, line 12 from top, for **"Liorynchus,"** read **"Liorhynchus."**
Page 323, line 6 from top, for **"Liorynchus,"** read **"Liorhynchus."**
Page 346, line 8 from bottom, for **"veristriata,"** read **"varistriata."**
Page 347, line 8 from top, for **"Aulipora,"** read **"Aulopora."**
Page 347, line 12 from top, for **"Hormatoma,'** read **"Hormotoma."**
Page 351, line 10 from top, for **"Tentaculties,"** read **"Tenaculites."**
Page 353, line 18 from top, for **"Sphaerocystitis,"** read **"Sphaerocystites."**
Page 353, line 21 from top, for **"Pseudocrintes,"** read **"Pseudocrinites."**
Page 353, line 23 from top, for **"Lepocrintes,"** read **"Lepocrinites."**
Page 357, line 5 from top, for **"Minaral,"** read **"Mineral."**
Page 360, line 22 from top, for **"mikht,"** read **"might."**
Page 365, line 23 from bottom, for **"periam-,"** read **"perlam-."**
Page 373, line 22 from bottom, for **"pawpaw,"** read **"Pawpaw."**
Page 383, line 2 from top, for **"Hormatoma,"** read **"Hormotoma."**
Page 390, line 18 from bottom, for **"Meristena,"** read **"Meristina."**
Page 390, line 10 from bottom, for **"Hormatoma,"** read **"Hormotoma."**
Pape 417, line 6 from bottom, for **"Jomes,"** read **"James."**
Page 426, line 11 from top, for **"Modioiopsis,"** read **"Modiolopsis."**
Page 553, line 19 from top, for **"124,"** read **"123."**
Page 553, line 22 from top, for **"125,"** read **"124."**
Page 607, line 15 from top, for **"159,"** read **"154."**
Page 724, line 15 from bottom, for **"Orthothetes,"** read **"Orthotetes."**
Page 725, line 6 from top, for **"Orthothetes,"** read **"Orthotetes."**
Page 726, line 3 from top, for **"Orthothetes."** read **"Orthotetes."**
Page 726, line 16 from top, for **"Ischilina,"** read **"Isochilina."**
Page 727, line 8 from bottom, for **"Orthothetes,"** read **"Orthotetes."**
Page 738, line 2 from bottom, for **"Paleantina,"** read **"Paleanatina."**
Page 744, line 24 from bottom, for **"desussata,"** read **"decussata."**
Page 757, line 11 from bottom, for **"Hormatoma,"** read **"Hormotoma."**
Page 758, line 20 from top, for **"Aulipora,"** read **"Aulopora."**
Page 760, line 25 from bottom, for **"Hormatoma,"** read **"Hormotoma."**
Page 761, line 2 from bottom, for **"Hormatoma,"** read **"Hormotoma."**
Page 763, line 2 from top, for **"Hormatoma,"** read **"Hormotoma."**
Page 766, line 10 from top, for **"Hormatoma,"** read **"Hormotoma."**

PART I.

History and Physiography.

CHAPTER I.

HISTORICAL AND INDUSTRIAL DEVELOPMENT.

LOCATION.

Mineral and Grant Counties comprise the area treated in this Report. They are situated in the northeastern part of West Virginia, being included between the parallels of 39° 39′ and 38° 48′ North Latitude, and the meridians of 78° 39′ and 79° 30′ West Longitude from Greenwich. In its general appearance on the map this territory has the form of a rough quadrilateral, having the approximate outlines of a longitudinal section cut from the frustum of a cone, the base of which, along the southwestern edge of Grant County, is 32 miles long, and the truncated apex of which, at the northeastern end of Mineral County, is only 10 miles, and the longitudinal axis of which is 60 miles.

Mineral County, occupying the northeastern portion of the area, is bounded on the north by Garrett and Allegany Counties, Maryland, on the east by Allegany County, Maryland, and Hampshire County, West Virginia, on the south by Hampshire, Hardy (at corner only), and Grant Counties, and on the west by Garrett and Allegany Counties, Maryland.

Grant County, located in the southwestern part of the area, is bounded on the north by Garrett County, Maryland, and Mineral County, West Virginia, on the east by Hampshire (at corner only) and Hardy, on the south by Hardy,

Pendleton, and Tucker, and on the west by Pendleton, Randolph, Tucker, and Preston (at corner only), and Garrett County, Maryland. The entire area of both counties is drained by waters of the Potomac River, tributary to the Atlantic Ocean through Chesapeake Bay, Mineral and northern Grant being wholly included within the drainage basin of North Branch of this river, while southern Grant is drained by the South Branch.

The geographical position of the two counties may be observed on Figures 1 and 2 in this Volume, and in greater detail on Maps I-IV, inclusive, enclosed in a separate Atlas accompanying this Report.

TRANSPORTATION.

WATER WAYS.

Natural water transportation has played only a minor part in the economic development of the two counties. Prior to the advent of the railroads both the North and South Branches of the Potomac, as well as their larger tributaries, were utilized for floating logs toward tide-water, but the comparatively swift current of the North Branch, and the frequent stretches of shallow water along South Branch, which is more placid, have almost entirely precluded the use of either stream as an artery of trade. No attempt to build locks and dams on either branch has been made and it does not appear that such a project would ever be feasible from an economic standpoint.

Both counties, however, derived material benefit from the Chesapeake and Ohio Canal, which extends from tide-water up the main Potomac to the junction of the two branches 1½ miles below Green Spring, West Virginia, and thence follows the North Branch, through Maryland territory, to Cumberland, being just opposite the northeastern boundary of Mineral County. This canal, which was completed to Cumberland in 1850, and which is still operated during the summer seasons, has been an economic factor of no small importance in providing an eastward outlet for coal, lumber, and other raw materials and a westward route for heavy merchandise.

STEAM RAILROADS.

Baltimore and Ohio Railroad—Main Line.

The main line of the Baltimore and Ohio Railroad, having its eastern terminal in New York City, and extending west-

ward to Philadelphia over leased trackage, and thence with its own road-bed to Cumberland, Maryland, where it divides into two principal branches, one of which passes northwestward through Pittsburgh to Chicago, and the other of which extends southwestward through West Virginia to Cincinnati and St. Louis, was for many years the only railroad outlet of the two counties. The construction of this road was begun at Baltimore, Maryland, July 4, 1828; was completed to Harpers Ferry, West Virginia, in 1832; to Cumberland, Maryland, November 5, 1842; to Piedmont, West Virginia, in 1851, and to Grafton, West Virginia, in 1852, beyond which latter point its further history need not be discussed in this Report. This road enters Mineral County 2.3 miles west of Green Spring and follows along its northeastern border 6.0 miles to North Branch Station, where it crosses North Branch of the Potomac and generally follows this stream to Cumberland, Maryland, a distance of 5.8 miles, and thence extends southwestward along the Maryland side of North Branch, 21.0 miles to Twenty-first Bridge, 2.0 miles east of Keyser, and then crosses North Branch into Mineral County, and extends westward through Keyser and Piedmont to Bloomington, Maryland, where it passes out of the county and continues westward, the distance from Twenty-first Bridge to Bloomington being 9.1 miles and the total main line trackage in Mineral County being 15.1 miles. In addition to ample sidings and yards at several points the entire line through this region is double-tracked.

To avoid freight congestion at Cumberland an auxiliary double-tracked line has been built from McKenzie, Maryland, through Knobly Mountain by tunnel, and thence to Patterson Creek, West Virginia, a total distance of 6.2 miles, of which 5.6 miles is in Mineral County. According to C. W. Wolford, Secretary, this work was begun in May, 1900, and completed in October, 1903. No passenger service is provided over this cut-off.

Baltimore and Ohio Railroad — Petersburg Branch. — The Petersburg Branch of the Baltimore and Ohio Railroad, tributary to the main line at Green Spring, Hampshire County, West Virginia, is a single-tracked line extending southwestward to Romney, Moorefield, and Petersburg, a distance of 51.6 miles. Hon. John J. Cornwell, of Romney, who has been closely identified with the various interests that built this branch, gives the following interesting account of its construction and corporate history, under date of April 12, 1922:

"The construction of the fifteen miles between Green Spring and Romney was begun about 1871. When the business depression of 1872-3 came on it was abandoned and lay in an unfinished condition until about 1883, being completed in May, 1884. It was built by the South Branch Railroad Company, a local corporation, to which Springfield and Romney Magisterial Districts subscribed a little stock each as did a number of private citizens. The B. & O. bought the bonds and a few years ago when the latter Company acquired all the branches owned by separate corporations whose stock it held, this branch, along with others, was conveyed to the B. & O. as a part of the general system.

"The road from Romney to Petersburg was constructed by the Hampshire Southern Railroad Company, the construction having been begun in June, 1909. It was completed to Petersburg in the spring of 1911 and operated by the Hampshire Southern Railroad Company about four years and then acquired by the B. & O. and made a part of the general system."

The Western Maryland Railway—Main Line.

The main line of the Western Maryland Railway, extending from Baltimore, Maryland, westward, via Cumberland, to Belington, Barbour County, West Virginia, a distance of 292.3 miles, and having a coal, general freight, and passenger business, is an important commercial carrier in Mineral and Grant Counties. In this territory its line closely follows the North Branch of Potomac River, being partly in West Virginia and partly in Maryland. Entering Mineral County at a bend in the Potomac 3 miles south of Cumberland, Maryland, it remains in Mineral County for 0.8 mile, then crosses into Maryland for 1 mile, but comes back into Mineral at a tunnel in South Cumberland and continues to Riverside Station, a distance of 5 miles, then crosses into Maryland for a short stretch of 1.2 miles, then returns into Mineral County for a length of only 0.6 mile, and recrosses into Maryland at Pinto Station, and passing through McCool, opposite Keyser, and Westernport, opposite Piedmont, crosses again into Mineral County at Luke. From this point southwestward it lies in Mineral County, a distance of 25.2 miles, to a point one-half mile north of the mouth of Stony River where it crosses into Maryland and so remains to Bayard where it recrosses the river into Grant County and continues on the same side a distance of 12.1 miles to Fairfax Summit, where it enters Tucker County. Its total main line trackage in Mineral County is 31.6 miles, and in Grant 12.1 miles, making a total of 43.7 miles for the two counties. At the western end of the South Cumberland Tunnel it connects with the Cumberland and Connellsville Division, which extends westward from the former to the latter point in Pennsylvania, a distance of 88.4 miles.

According to L. F. Timmerman, Secretary and Treasurer, this road was formerly operated under the corporate name of Western Maryland Railroad Company, and extended from Baltimore only to Big Pool, Maryland, but on August 6, 1906, was merged into a trunk line by the completion of a connection 60 miles long from the latter point to Cumberland, where it connected with and absorbed the West Virginia Central and Pittsburgh Railway. The latter corporation was first organized in 1866 as the Potomac and Piedmont Coal and Railroad Company and was built from Cumberland to Westernport (opposite Piedmont) at a later date. This road was reorganized under the name of West Virginia Central and Pittsburgh Railway June 25, 1881. According to Maxwell[1] construction from Westernport westward was begun about April 20, 1880, and was completed to Elk Garden October 29, 1881; to Thomas and Davis November 1, 1884; to Parsons early in 1889; to Elkins August 18, 1889; and to Belington May 1, 1891. Its organization and construction was due largely to the shrewd foresight and ability of the late Senator Henry G. Davis.

The Western Maryland Railway—Elk Garden Branch.—The Elk Garden Branch of the Western Maryland Railway, completed October 29, 1881, extends 7 miles from Harrison, Mineral County, up Abram Creek, via Oakmont and Emoryville to Elk Garden on a high plateau, having been built primarily to afford an outlet for the Pittsburgh, or "Big Vein," Coal of that locality. Although but little of this coal now remains the branch is still in operation and affords general freight and passenger service.

Babcock Lumber and Boom Company Railroad.

The Babcock Lumber and Boom Company Railroad, which is an important standard-gauge feeder for the Western Maryland Railway, extends from its connection with the latter line at Davis, Tucker County, up the Blackwater River into the Canaan Valley and thence across Cabin Mountain into the Stony River Valley, and skirting the eastern shore of Stony River Dam continues to the summit of the Allegheny Front, where construction southeastward down the mountain is now in progress. Its total main line trackage is 19 miles of which that portion east of the summit of Cabin Mountain, comprising 7.3 miles, is in Grant County. Its principal function is that of hauling logs to the company mill at Davis, no general freight or passenger service being

[1]Hu Maxwell, History of Randolph County, pp. 287-289; 1898.

afforded. Construction of this road was begun soon after the Western Maryland Railway reached Davis and during the various ownerships through which the road has passed its lines have radiated in many directions, most of them having now been removed except the line described above and the Beaver Creek Branch which lies wholly in Tucker County. It was acquired by the present ownership in 1907.

Cumberland and Pennsylvania Railroad.

The Cumberland and Pennsylvania Railroad extends from Cumberland westward via Mount Savage to Frostburg, and thence southward down Georges Creek via Lonaconing and Westernport, all in Maryland, to Piedmont, Mineral County, West Virginia, a distance of 32.9 miles, of which only about one-third mile is in Mineral County. Although doing a general freight and passenger business the chief function of this road is as a coal carrier for the mines of the Georges Creek Valley. The following statement by J. T. Robertson, General Manager, of Cumberland, Maryland, gives an interesting account of the history of this railroad:

"The Cumberland and Pennsylvania Railroad Company was incorporated by the Act of the General Assembly of Maryland in 1849. It originally consisted of several short lines of track which were purchased and consolidated under the name of the above company.

"On January 2, 1854, it purchased the track of the Mt. Savage Iron Company, extending from Cumberland, Md., to Borden Yard, Md., 14 miles. It constructed its own track from Borden Yard, Md., to about one mile east of Lonaconing, Md., during 1856 and 1857 (where this latter track connected with that of the Georges Creek Coal & Iron Company), a distance of 9.7 miles, making a total mileage up to that time of 23.7. On October 23, 1863, it purchased the track of the Georges Creek Coal & Iron Company, extending from a point about one mile east of Lonaconing to Piedmont, W. Va., a distance of 9.2 miles. This made a line of through track from Cumberland, Md., to Piedmont, W. Va., a distance of 32.9 miles.

"No corporate changes have been made.

"The Cumberland and Pennsylvania Railroad Company has physical connection with the B. & O. Railroad at Piedmont, W. Va., and Cumberland, Md.; with the Western Maryland Railway at Westernport, Md., and Cumberland, Md.; and with the Pennsylvania Railroad at State Line, Pa."

HIGHWAYS.

State Roads.

Previous to the Legislative session of 1921 all West Virginia roads were built and maintained under the direct supervision of the various County Courts, supplemented to some extent by Government and State aid, the more important high-

ways having been designated as Class "A" roads. Under the law of 1921 the Class "A" roads, for the most part, have been taken over by the State, their construction and maintenance being under the supervision of the State Road Commission, with funds supplied from State and Government revenues. Under this law the Commission has entirely revised the former Class "A" roads and has projected a complete system of connecting "State Routes" which, when constructed and hard surfaced, will be known as "State Roads," the former title of Class "A" Roads having become obsolete. According to Mr. B. E. Gray, of Keyser, Division Engineer of the State Road Commission, the following State Routes have been designated for Mineral and Grant Counties:

State Routes, Mineral County.

"Beginning at Cumberland, thence southerly through Ridgeley, Alaska, and across the County Line to Springfield and Romney.

"Beginning at Piedmont, thence easterly to Keyser, thence southerly along the New Creek Pike, through Claysville and Hartmansville to the Grant County Line.

"Beginning at Blaine, and proceeding in a southeasterly direction through Elk Garden, and Sulphur City, to an intersection with the Northwestern Pike near Hartmansville.

"Beginning at the Hampshire County Line on the Romney-Keyser road and proceeding westerly to an intersection with the New Creek Pike near Rees Tannery (Newcreek)."

State Routes, Grant County.

"Beginning at Gormania, and proceeding in a northeasterly direction, through Mount Storm, to the Mineral County Line.

"Beginning at Mount Storm and proceeding in a southerly direction through Bismarck, Scherr, Greenland Gap, Maysville, and Arthur, to Petersburg, thence southerly through Pansy and Landes, to the Pendleton County Line.

"Beginning at Petersburg and proceeding in an easterly direction to the Hardy County Line on the Petersburg-Moorefield road."

Of the above State Routes in Mineral County grading has been completed from Cumberland southward to Knobly, a distance of 6 miles. From Piedmont eastward the road is hard surfaced to a road fork one-half mile south of Claysville, a distance of 13½ miles, and the same road up New Creek, although not a State Route, has been hard surfaced to the Grant County Line, a further distance of 6 miles. On the road from Blaine southeastward grading is completed to the intersection with the Northwestern Pike, a distance of 7 miles. On the road between the Hampshire County Line and New Creek several miles have been recently graded. Of the Grant County routes named six miles of the Mt. Storm-Petersburg-

Pendleton road have been graded, 2½ miles of this improvement being immediately north of Petersburg and the remaining 3½ miles immediately south of the same town.

Northwestern Turnpike.—The various State Routes detailed for the two counties include, under separate headings, all of the old Northwestern Turnpike which traverses them in an east and west direction. This historic thoroughfare was incorporated by the State of Virginia on February 27, 1827, and was made a State enterprise in 1831, being completed in 1838, between Winchester, Virginia, and Parkersburg, now in West Virginia. Passing through Romney and entering Mineral County 1¼ miles northeast of Junction, it extends westward through Claysville and thence across the Allegheny Front via Hartmansville, beyond which it enters Grant County and by way of Mount Storm reaches Gormania on the North Branch of Potomac River, where it passes into Maryland.

County Roads.

With the exception of that portion of Grant County lying west of and including the Stony River drainage, both Mineral and Grant are well supplied with county dirt roads, many of which have been partly improved with chert or gravel, and nearly all of which may be traversed by automobile during a considerable portion of the year, due to the fact that the soil is generally sandy. According to the Report of the State Road Commission for 1914, Mineral County has 300 miles and Grant County 311 miles of roads, those now designated as State Routes being included in these figures.

GENERAL DESCRIPTION, MINERAL COUNTY.

MISCELLANEOUS ITEMS.

Formation.—Mineral County, deriving its name from the coal and other natural deposits within its boundaries, was formed from Hampshire by Act of the West Virginia Legislature passed February 1, 1866, as follows:

"Be it enacted by the Legislature of West Virginia:

"1. So much of the county of Hampshire as is included within the following boundary lines, to-wit: Beginning at the point where the dividing line between the county of Hardy and the said county of Hampshire intersects the line between this state and the state of Maryland, thence running with said line between said counties of Hardy and Hampshire, crossing Patterson's creek to the dividing line between the townships of Welton and Romney, in the said county of Hampshire, on the top of Middle Ridge, thence along the top of Middle Ridge and with the same line between the townships of Welton and

Romney, to the dividing line between the townships of Frankfort and Springfield in the said county of Hampshire; thence along the top of said Middle Ridge and with the said line between the said townships of Frankfort and Springfield to the Maryland line, thence with the dividing line between this state and the state of Maryland to the place of beginning, shall form one distinct and new county, which shall be called and known by the name of Mineral County."

The above boundary partition remained in force until February 29, 1868, when a further change was made by Act of the Legislature, as follows:

"Be it enacted by the Legislature of West Virginia:

"1. The division line between the counties of Hampshire and Mineral is hereby altered so as to run as follows, to-wit: Beginning at the present corner of Hampshire and Mineral in the Hardy line, running with the said line between Hampshire and Hardy to the top of what is known as the high knob on Mill Creek Mountain; thence, leaving said line, running along the top of said mountain to Mien's gap and crossing it, and with the same mountain range to a point opposite what is known as Herriott's divide, (between Herriott's and Hamilton's); thence with said divide and the same course continued to the top of Middle range, there intersecting the present line between the counties of Hampshire and Mineral, and thence running with the same to the Maryland line; said territory to constitute a township known as Mill Creek township, to be organized and governed as the other townships of the said county of Mineral."

The above Act also further specified that a vote of the territory affected should be taken and that the line should be run by three commissioners before the change should be effective, and presumably these details were carried out. There being further dissatisfaction with this partition an Act was passed on February 8, 1872, which appears to have definitely established the line between the two counties by cutting off the territory which now constitutes Mill Creek District, and returning the same to Hampshire County, as follows:

"Be it enacted by the Legislature of West Virginia:

"That the act passed the twenty-ninth day of February, 1868, entitled 'An act to alter part of the division line between the counties of Hampshire and Mineral,' be and the same is hereby repealed, and the territory by said act annexed to and made part of the county of Mineral, is hereby re-annexed to, and made part of the county of Hampshire, and the township constituted by said act shall continue to be known as Mill Creek township, to be governed as other townships of the said county of Hampshire, and all officers therein shall continue to perform their duties until their successors are duly elected and qualified, or until otherwise ordered by law."

Area.—The present area of Mineral County, as determined with planimeter by R. C. Tucker from the topographic sheets of the United States Geological Survey, is as follows:

Districts.	Square Miles.
Frankfort	98.70
Cabin Run	58.10
Welton	51.10
New Creek	60.50
Piedmont	8.95
Elk	52.65
Total	330.00

Relief.—The surface of Mineral County varies in elevation from 545 feet on the North Branch of Potomac River at the northeastern corner of the county, 2.3 miles west of Green Spring, to 3,250 feet at a high knob on the Allegheny Front, 1.8 miles northeast of Hartmansville, near the southern boundary, making a total difference of 2,705 feet.

Climate.—From the standpoint of climate Mineral County may be divided into two zones, due to the large topographic relief. Along the North Branch of Potomac River and its tributaries below Piedmont, the summer season is comparatively long and the winters not unduly severe, but on the Potomac above Piedmont, where the elevation rapidly increases southwestward and where the valley is closely hemmed by high mountains, and on the extensive Allegheny plateau region southwest of Piedmont short summers, with late spring and early fall frosts, are the rule, and the winter season is much colder than that of the lowlands. No figures are available to show the annual or seasonal difference of temperature between the two zones but it is probable that this variation will average ten degrees or more, as it is quite perceptible in passing from the lowlands to the plateau region. Naturally there is a corresponding difference in native vegetation and in the crops that may be cultivated in the two zones. In all parts of the county the climate is healthful and climatic diseases of a serious nature are unknown. The following statistics concerning temperature and precipitation at Piedmont and the same data in addition to snowfall at Burlington, furnished by H. C. Howe, Section Director, United States Weather Bureau, Parkersburg, West Virginia, give the main climatological facts, the observations at Piedmont having been taken by Mr. C. A. Suter, Jr., and those at Burlington by Mr. J. W. Vandiver, and both points being in the lowland region:

Monthly, Annual, and Mean Temperature, in Degrees and Tenths, at Piedmont, W. Va.

(Record made by C. A. Suter, Jr.).

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Ann.
1915	.....	.....	.....	.....	.....	.....	74.0	70.4	68.7	56.1	43.4	31.4	.....
1916	36.0	31.4	36.0	49.0	63.1	63.4	71.1	72.4	62.0	51.0	40.3	30.4	50.5
1917	32.5	31.5	39.8	51.1	55.8	67.1	72.4	70.7	60.8	48.2	40.4	24.0	49.5
1918	19.6	33.2	45.9	50.6	66.8	67.4	69.8	73.8	60.0	54.0	40.2	36.9	51.5
1919	34.6	34.4	43.0	50.4	60.8	72.2	73.3	69.3	66.0	60.2	43.2	27.6	52.9
1920	25.8	29.4	42.8	47.6	56.2	66.9	69.3	68.8	64.8	57.2	40.4	34.0	50.3
1921	33.5	35.0	50.8	56.4	60.2	71.0	75.6	68.2	71.2	52.8	44.4	34.9	54.5
Av.	30.3	32.5	43.0	50.8	60.5	68.0	72.2	70.5	64.8	54.2	41.8	31.3	51.5

Precipitation: Monthly, Annual, and Average Amounts, in Inches and Hundredths, at Piedmont, W. Va.

(Record made by C. A. Suter, Jr.).

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Ann.
1915	.....	.....	.....	.....	.....	.....	2.98	4.85	2.00	3.90	1.92	2.83	.....
1916	2.71	1.79	5.42	2.51	2.08	4.15	3.10	1.76	1.78	2.36	1.50	2.32	31.48
1917	3.80	2.46	7.67	2.53	3.26	2.25	4.11	5.53	2.62	2.17	0.25	0.79	37.44
1918	4.82	2.71	2.71	6.75	4.60	3.15	2.92	3.51	2.68	2.80	0.93	4.82	42.40
1919	1.76	1.71	2.39	1.81	4.11	4.15	6.38	2.96	1.33	4.59	1.98	2.36	35.53
1920	2.78	3.06	2.05	4.92	2.38	6.07	3.81	6.82	2.49	2.08	3.02	1.73	41.21
1921	1.93	2.29	2.00	1.68	6.15	3.02	5.64	4.78	4.71	1.72	4.43	2.29	40.64
Av.	2.97	2.34	3.71	3.37	3.76	3.80	4.13	4.32	2.52	2.80	2.00	2.45	38.17

Monthly, Annual, and Mean Temperature, in Degrees and Tenths, at Burlington, W. Va.

(Record made by J. W. Vandiver.)

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Ann.
1894	36.5	32.8	45.7	49.6	62.9	72.2	74.8	71.9	67.3	54.0	37.9	33.7	53.3
1895	24.1	22.0	37.4	48.6	59.9	69.3	.....	.....	.....	.....	.....	.....	.....
1896	29.6	33.9	33.9	55.2	66.0	68.2	73.0	71.2	63.6	49.0	49.0	33.3	52.2
1897	27.8	34.4	40.6	50.6	57.8	67.8	73.7	70.3	64.4	55.2	43.3	36.4	51.9
1898	34.7	32.3	46.4	47.2	63.0	70.2	75.2	73.2	64.7	52.6	39.6	31.6	52.6
1899	29.8	23.3	39.6	52.4	63.2	71.1	73.6	73.2	64.0	54.7	43.5	32.2	51.7
1900	32.4	29.4	37.0	52.0	62.4	71.1	74.6	76.0	71.1	58.6	46.7	33.0	53.7
1901	32.2	27.0	42.0	48.8	60.8	69.1	77.3	72.9	63.0	52.1	37.7	29.5	51.0
1902	28.6	24.1	40.6	48.5	62.2	67.6	74.4	70.3	63.1	55.0	48.4	32.5	51.3
1903	28.2	32.2	48.8	50.3	62.3	63.5	72.0	70.8	62.6	54.3	36.6	27.4	50.8
1904	23.2	25.0	40.7	46.8	61.2	67.6	70.6	69.0	62.4	51.2	38.8	28.6	48.8
1905	27.0	24.6	42.4	50.8	63.0	69.0	72.5	71.4	63.8	51.6	40.9	34.8	51.0
1906	36.7	30.4	35.2	52.8	61.0	69.3	71.2	72.5	67.6	51.4	44.8	34.3	52.3
1907	34.9	27.6	46.3	45.8	57.8	63.2	67.2	68.2	66.2	49.5	41.0	33.0	50.1
1908	30.1	27.9	45.6	54.0	62.0	68.3	71.1	70.2	66.0	54.8	43.0	36.6	52.7

Monthly, Annual, and Mean Temperature, in Degrees and Tenths, at Burlington, W. Va.—Continued.

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Ann.
1909	34.2	41.5	40.5	52.2	61.4	71.1	69.6	70.2	63.0	49.6	47.8	29.2	**52.5**
1910	32.1	32.0	48.7	53.8	59.0	67.8	74.0	70.8	67.2	57.4	39.2	27.8	52.5
1911	35.2	37.3	39.6	49.2	66.5	72.2	73.2	72.8	65.6	55.1	39.8	38.2	**53.7**
1912	22.8	27.6	40.0	52.9	62.1	64.8	.....	66.6	67.4	55.7	44.2	35.0	.....
1913	38.2	33.5	45.4	51.6	60.0	68.7	72.0	.....	62.1	54.0	43.3	36.0	.....
1914	33.4	26.0	35.3	50.1	62.2	70.8	71.8	70.2	61.0	56.0	40.9	29.0	50.6
1915	29.6	34.8	34.8	54.8	57.9	65.4	71.7	70.4	66.1	54.6	42.4	32.0	51.2
1916	35.4	31.4	35.9	50.0	63.6	65.0	73.4	73.6	61.5	50.9	40.6	32.0	51.1
1917	31.2	30.4	39.5	51.4	56.0	67.4	73.2	71.9	59.8	47.6	38.8	22.9	49.2
1918	19.0	32.4	44.8	49.1	66.2	66.2	69.3	73.2	59.4	55.4	40.9	37.6	51.1
1919	33.2	34.0	42.2	49.9	59.5	70.6	72.8	69.0	64.3	59.0	42.8	26.8	52.0
1920	25.6	29.6	42.3	47.2	56.5	66.5	68.6	70.0	63.7	56.0	41.4	34.3	50.1
1921	33.6	35.2	50.4	55.4	59.5	69.2	75.0	70.0	69.6	52.2	43.8	35.5	**54.1**
Av.	30.7	30.4	41.5	50.8	61.3	68.3	72.6	71.1	64.5	53.6	42.1	32.3	**51.7**

Precipitation: Monthly, Annual, and Average Amounts, in Inches and Hundredths, at Burlington, W. Va.

(Record made by J. W. Vandiver.)

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Ann.
1894	1.20	3.30	T	2.55	3.35	3.26	1.82	2.52	4.15	2.70	0.25	2.65	27.75
1895	2.40	1.07	3.95	1.40	1.25	4.84	2.24	2.44	0.50	1.25	0.60	2.00	23.94
1896	1.60	4.08	3.60	2.05	3.28	5.41	7.82	2.69	5.85	0.95	3.60	1.29	42.22
1897	1.21	6.43	1.43	2.03	5.06	1.31	4.16	1.69	1.67	0.85	3.84	3.27	32.95
1898	3.87	1.45	5.09	3.73	4.78	0.66	1.92	8.21	1.52	5.05	1.95	2.55	40.78
1899	3.25	4.30	4.50	1.25	6.94	3.72	2.18	1.06	4.41	2.32	1.10	1.55	36.58
1900	0.82	2.99	3.31	0.85	1.45	3.63	4.16	1.03	1.94	1.55	4.09	1.85	27.67
1901	1.95	0.25	2.40	5.46	6.97	5.62	1.25	6.99	2.40	0.15	2.30	5.80	41.54
1902	2.50	4.55	4.40	2.95	1.80	4.71	1.65	3.02	2.47	2.85	2.68	3.87	37.45
1903	3.35	3.42	2.85	3.50	2.62	3.86	3.94	4.17	1.88	2.32	0.83	0.86	33.60
1904	2.40	1.95	2.03	1.45	3.41	2.21	3.70	2.22	2.35	1.44	0.68	2.68	26.52
1905	2.45	0.90	3.90	1.83	4.54	4.68	10.64	5.10	1.95	3.65	1.10	3.75	44.49
1906	2.27	1.00	5.55	1.50	1.22	6.13	2.40	6.68	2.09	1.93	1.20	4.32	36.29
1907	3.40	1.90	2.70	1.89	3.56	5.46	3.11	2.68	5.96	0.60	3.48	2.90	37.64
1908	2.60	2.90	5.30	1.75	11.45	2.55	4.72	3.11	0.75	0.83	1.00	2.05	39.01
1909	3.08	1.80	1.55	6.47	3.73	5.91	0.90	2.55	3.23	3.45	0.32	1.95	34.94
1910	4.10	1.80	0.40	3.77	3.10	7.50	4.50	2.84	2.28	0.80	1.27	1.30	33.66
1911	6.43	1.45	2.60	2.10	0.20	5.19	2.65	5.57	4.30	3.95	1.45	3.10	38.99
1912	1.50	2.60	3.30	2.00	4.00	2.53	5.00	0.25	4.20	0.20	1.30	1.45	28.33
1913	2.10	0.50	4.15	1.75	7.08	3.97	3.27	2.00	2.15	5.58	3.13	3.25	38.93
1914	2.80	3.90	2.00	4.22	1.00	1.92	4.09	4.80	1.60	2.50	1.05	2.58	32.46
1915	2.00	1.62	1.10	1.75	4.33	4.35	3.84	7.97	2.95	4.20	1.55	3.45	39.11
1916	1.99	2.00	5.23	4.20	2.31	4.23	3.25	1.47	4.95	1.48	1.32	1.31	33.74
1917	4.07	2.25	4.95	2.62	4.24	2.12	3.73	3.65	3.03	2.90	0.30	0.80	34.76
1918	2.95	1.95	1.55	6.50	2.91	3.55	2.23	6.03	3.53	2.27	0.98	4.40	38.85
1919	2.44	1.77	2.08	1.70	4.10	2.38	5.13	3.45	1.42	3.81	1.90	3.05	33.23
1920	2.79	2.40	2.75	5.16	1.08	5.55	3.86	7.00	4.76	0.73	3.01	1.64	40.73
1921	0.60	2.23	1.87	1.23	6.48	1.49	2.47	3.96	4.43	1.38	3.10	2.85	32.09
Av.	2.58	2.39	3.02	2.77	3.79	3.88	3.59	3.76	2.95	2.20	1.76	2.59	35.28

Monthly, Annual, and Average Snowfall, in Inches and Tenths, at Burlington, W. Va.

(Record made by J. W. Vandiver.)

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Ann.
1894	8.0	.....	.....	6.0	.....	.....	.....	.....	.....	.....	1.5	.....	.....
1895	14.5	12.0	7.0	.....	.....	.....	.....	.....	.....	.....	.....	12.0	45.5
1896	1.0	5.0	2.9	1.0	.....	.....	.....	.....	.....	.....	3.0	6.0	18.9
1897	2.5	10.0	4.0	.....	.....	.....	.....	.....	.....	.....	T	1.0	17.5
1898	T	1.5	3.0	3.0	.....	.....	.....	.....	.....	.....	4.0	4.0	15.5
1899	9.0	30.0	3.0	.....	.....	.....	.....	.....	.....	.....	T	2.5	44.5
1900	0.5	8.5	19.0	.....	.....	.....	.....	.....	.....	.....	T	1.0	29.0
1901	2.0	1.0	2.0	3.0	.....	.....	.....	.....	.....	.....	2.0	2.0	12.0
1902	10.0	5.0	22.0	12.0	.....	.....	.....	.....	.....	T	T	9.0	58.0
1903	6.5	8.0	0.2	T	.....	.....	.....	.....	.....	.....	T	4.2	18.9
1904	17.0	6.5	3.0	1.0	.....	.....	.....	.....	.....	.....	T	13.0	40.5
1905	21.0	9.0	7.0	1.0	.....	.....	.....	.....	.....	.....	T	8.0	46.0
1906	4.0	9.0	23.0	T	.....	.....	.....	.....	.....	T	1.0	6.0	43.0
1907	7.0	19.0	10.0	T	.....	.....	.....	.....	.....	.....	4.0	13.0	53.0
1908	16.0	29.0	T	0	T	.....	.....	.....	.....	.....	10.0	7.0	62.0
1909	16.0	9.0	6.0	3.0	.....	.....	.....	.....	.....	.....	T	4.0	38.0
1910	20.0	17.0	3.0	T	.....	.....	.....	.....	.....	T	T	13.0	53.0
1911	9.0	9.0	16.0	3.5	.....	.....	.....	.....	.....	.....	T	T	37.5
1912	14.0	3.0	6.0	.....	.....	.....	.....	.....	.....	.....	T	10.0	33.0
1913	3.0	3.0	T	T	.....	.....	.....	.....	.....	T	T	3.5	9.5
1914	12.0	28.0	19.0	.....	.....	.....	.....	.....	.....	.....	.....	15.0	74.0
1915	13.0	4.0	10.0	.....	.....	.....	.....	.....	.....	.....	.....	5.0	32.0
1916	4.0	12.0	7.0	7.0	.....	.....	.....	.....	.....	.....	.....	6.0	36.0
1917	8.0	12.0	27.0	1.0	.....	.....	.....	.....	.....	.....	2.0	8.0	58.0
1918	29.0	3.0	0	20.0	.....	.....	.....	.....	.....	.....	.....	2.0	54.0
1919	7.0	4.0	T	.....	.....	.....	.....	.....	.....	.....	T	10.0	21.0
1920	4.5	22.0	T	3.0	.....	.....	.....	.....	.....	.....	8.0	T	37.5
1921	3.0	15.0	0	T	.....	.....	.....	.....	.....	T	.....	13.0	31.0
Av.	9.3	10.9	8.0	3.4	T	.....	.....	.....	.....	T	1.6	6.6	39.8

Population.—The following table, taken from the United States Census returns for 1920, shows the population of Mineral County for the last three enumerations:

Population of Mineral County.

Minor Civil Division.	1920.	1910.	1900.
Cabin Run District	900	884	827
Elk District, including Elk Garden town	3,539	3,825	2,597
Elk Garden town	422	438	581
Frankfort District, including Ridgeley town	3,486	2,538	1,807
Ridgeley town	1,709	.....	.....
New Creek District (a), including Keyser city	7,484	6,040	4,038
Keyser city (a)	6,003	3,705	2,536
Piedmont District, including Piedmont town	3,602	2,635	2,814
Piedmont town	2,835	2,054	2,115
Welton District	838	752	800
Totals for County	19,849	16,674	12,883

(a), Part of New Creek District (South Keyser town) annexed to Keyser city since 1910.

For the period covered by the above returns there is an increase in population of 54.1 per cent., as compared to 52.7 per cent. for the entire State during the same time interval. In density of population the county has 60.1 inhabitants per square mile, as compared to 59.8 for the entire State (the latter being figured on a State area of 24,497 square miles which the Survey regards as more accurate than the 24,022 square miles used in the Census).

Products.—The principal animal products are cattle, horses, sheep, hogs, poultry, mules, and bees, their value being in the order named.

The principal agricultural products and fruits are corn, potatoes, wheat, oats, hay, buckwheat, rye, apples, peaches, pears, cherries, grapes and plums, their relative value being uncertain. Within the past few years there has been a great development of the orchard industry on the chert lands of Knobly and other mountains, this particular type of soil having proved to be especially suitable for the culture of fruit. Many of these orchards are still too young to be productive, but their future growth and yearly crop will assure to the county an economic asset of prime importance. The chert lands, on which these fruits thrive to the best advantage, occur in the intermediate zone between the Oriskany Sandstone and the Helderberg Limestone where percolating water has dissolved the top of the limestone and replaced it by liquid silica from the sandstone, forming the chert, within the crevices of which a considerable portion of the residual limestone soil still remains, affording the fertile condition required by the trees.

The principal mineral and manufactured products now in a stage of development are coal, lumber, limestone, brick, silk, wool yarns, and plumbers' earthenware.

Property Valuation.—According to Hon. John C. Bond, State Auditor, the following table shows the property valuation for Mineral County for three years; the figures for 1922 being by Mr. T. T. Huffman, Clerk of the County Court of Mineral County:

	1919	1920	1921	1922
Real Estate	$ 6,021,700	$ 6,280,390	$ 6,475,480	$10,408,870
Personal Property	4,148,250	4,363,840	4,550,950	4,071,640
Public Service Corporations	5,905,069	6,101,645	5,967,646	8,216,626
Totals	$16,075,019	$16,745,875	$16,994,076	$22,697,136

A comparison of the above figures with those for other counties in the Auditor's Report for 1921, the last year in which complete returns are available, shows that Mineral ranks 37th in point of wealth in the State. On account of a

radical revision of property assessments in 1922 there is a heavy increase in valuations for that year that should not be considered as indicating any unusual economic development.

Postal Service.—Mineral County is served partly by railway mail and partly by star route and rural free delivery carriers, there being three rural routes. City or village delivery is afforded in Keyser and Piedmont. The following table, compiled from the United States Official Postal Guide shows the number of post-offices in the county. Figures following the names of offices indicate the number of rural free delivery routes starting therefrom:

Alaska	Gleason	Potomac Manor
Antioch	Headsville	Reeses Mill
Barnum	Keyser—1	Ridgeley
Blaine	Laurel Dale	Ridgeville
Burlington—1	Newcreek	Russelldale
Champwood	Oakmont	Schell
Elk Garden—1	Pattersons Creek	Shaw
Emoryville	Piedmont	Wiley Ford

TOWNS AND INDUSTRIES.

Keyser.

Keyser, the county-seat of Mineral, was first known as New Creek, being so designated by the Act which established the county in 1866. Although specified at that time as the permanent county-seat it was evidently only a small village, as the same Act prescribed that Court should be held at Piedmont until a suitable court-house could be erected at New Creek. In its early days the town first became important as a supply point from which materials and supplies were hauled for long distances into central West Virginia during the Civil War of 1860-1865, being one of the most convenient and easily accessible railroad points, and there being a Federal fort on the land now occupied by the Potomac State School. According to R. A. Welch, Attorney, who was Mayor of Keyser for several years, its name was changed from New Creek to Keyser, in honor of Mr. William Keyser, a former Vice-President of the Baltimore and Ohio Railroad, on February 1, 1875, being incorporated as a town by action of the Circuit Court of Mineral County on the same date. In 1913 the State Legislature granted the town a city charter under which it now operates. In 1900 its population was 2,536, in 1910 it was 3,705, and in 1920 it increased to 6,003, some additional territory having been annexed. Situated partly on the low flood-plain of the North Branch of Potomac River, with an elevation of 809 feet above sea-level, and partly on the broad river terraces which stand at somewhat higher levels in the valley of New Creek, and being just below the

gap where the Potomac cuts through the great mountain escarpment known as the Allegheny Front in West Virginia and as Dans Mountain in Maryland, both of which are only a few miles away and clearly visible, and having the rough summits of New Creek and Knobly Mountains just to the eastward, the town of Keyser, with its broad streets, well-paved sidewalks, beautiful homes, large and well-kept industrial plants, and extensive railroad yards and shops, presents a scene of busy and healthful activity, combined with rare natural beauty, all of which may fortunately be seen in panorama by an easy climb to the top of Queens Point on the Maryland side of the river just north of the town. Aside from its position as a natural supply point for considerable portions of Mineral and Grant Counties and for part of Allegany County, Maryland, and in addition to the county business, which is considerable, Keyser has large railroad shops and classification yards and several industrial plants that compare favorably with others of their class throughout the State. In addition to these commercial features it is the location of one of the State collegiate schools. The town is served by the main lines of both the Baltimore and Ohio Railroad and the Western Maryland Railway, the latter being accessible on the Maryland side at McCool Station, with a freight switch also into Keyser proper.

Baltimore and Ohio Railroad Shops.—The Baltimore and Ohio Railroad maintains a large roundhouse and extensive car repair shops at Keyser, both being under the supervision of Augustus H. Hodges, Master Mechanic. According to M. A. Graney, General Foreman, the roundhouse was built in 1904, and has a capacity of 24 engine stalls, there being 400 men employed, of whom 150 are skilled workmen. According to E. B. Fazenbaker, Special Inspector, the car repair shop now in use was built about 1910, its floor capacity being 60 cars, and 525 men being normally employed, of whom 300 are skilled workmen, the remainder being apprentices, helpers, and laborers.

Edington & Company, Inc.—Edington & Company, Inc., located on the Potomac flood-plain at the north edge of Keyser, was first established as the Patchett Worsted Company in 1903, later succeeded by James Lees & Sons Company, and finally by the present corporation, the ownership of which dates from September 1, 1921. According to G. W. Brookfield, Acting Manager of this concern, the head office of which is at 489 Summer Street, Boston, Mass., the plant manufactures worsted yarns, its capacity being 10,000 pounds

Photo by E. E. HARRIS.

PLATE II.—View from Luke, Maryland, looking eastward across North Branch of Potomac River toward Dans Mountain in extreme background. Town of Piedmont, W. Va., in right middle and Westernport, Md., in left middle. Topography of Conemaugh, Allegheny, and Pottsville Series.

weekly, the raw material coming from the general market and the finished product going to the miscellaneous trade. The factory contains 2,500 spinning spindles, operated by 140 skilled workers of whom 100 are women.

Klots Throwing Company.—The Klots Throwing Company, with head office at 440 Fourth Avenue, New York City, established a plant in Keyser in 1920. According to Charles W. Walters, Superintendent, this concern manufactures silk throwing (silk thread), its capacity being 1,800 pounds weekly and there being 115 skilled workers employed, of whom 20 are men and the remainder women, with a monthly pay-roll of $4,500.

The Potomac Pottery Company.—The Potomac Pottery Company, having its head office and works at Keyser, northwest of the Baltimore and Ohio Railroad station, was established in August, 1913, having succeeded Potomac Valley Pottery Company which followed Keyser Pottery Company, the concern that built the plant in 1905. According to Frederick Byford, Manager, this factory makes plumbers' earthenware, its capacity being 500 sets weekly, the supply of kaolin used being partly domestic (United States) and partly imported, and the product going to the general jobbing trade. There are four bottle-kilns, and 30 men are employed of whom 95 per cent. are skilled, with a monthly pay-roll of $4,000.

Potomac State School.—The Potomac State School, located on Battle Hill at Keyser, and formerly known as the Keyser Preparatory Branch of the West Virginia University, but having the status of an independent State School since the 1921 meeting of the State Legislature, is described as follows by President Joseph W. Stayman in a letter dated April 20, 1922:

"This school was established by Act of Legislature in 1901 and first opened for students in the fall of 1902. The original building burned in 1917 and the present building, now known as the Main Building, was completed and occupied in the fall of 1920. The Dormitory was finished in 1916; it is known as the Dormitory Building, and is occupied by both boys and girls. This is practically two buildings in one, the two wings being separated by a dividing wall. The work of the school as now constituted is divided into four departments: Commercial, Home Economics, Regular Preparatory, and Collegiate. Four years of Preparatory work is given, the equivalent of a first class high school, and one year of college work was added at the beginning of the present school year. A second year of Collegiate work will be offered in 1922-23. This will enable the graduates of our school to enter the junior classes of any standard college or university. The number of teachers employed is thirteen,

with a pay-roll averaging monthly $2,250. The net enrollment for the present year will run about 175."

Piedmont.

Piedmont, located on the south side of the North Branch of Potomac River, opposite the mouth of Georges Creek and just west of the gap made by the river in the Allegheny Front and Dans Mountains, and having an elevation of about 915 feet above sea-level, is the second town in point of size and commercial importance and one of the first in point of historic interest. As its name of Latin derivation implies, it is situated at the foot of the mountains, being at the eastern end of the well-known "Seventeen-Mile Grade" of the Baltimore and Ohio Railroad, which ascends Backbone Mountain westward to Altamont, the highest point on the entire road. Laid out by the New Creek Company and incorporated by the General Assembly of Virginia in 1856, soon after the completion of the Baltimore and Ohio Railroad, its growth and industrial career have been mainly dependent on the railroad from which its chief sustenance is derived, although much of its earlier activity was due to the enterprise of the late Henry G. Davis, who began his railroad career as a telegrapher in the Piedmont station and who was closely connected with the pioneer mining and lumber industries of the upper Potomac. On February 27, 1866, a new charter, in amendment of the Virginia Act, was granted by the Legislature of West Virginia. In 1900 the population was 2,115, in 1910 it was 2,054, and in 1920 it was 2,835. On the flood-plain of the river north of the railroad many of the quaint structures of early days still remain but in later years the town has extended southward to the terrace lands and for a considerable distance up the slope of the Allegheny Front, the population being thickly congested owing to the scarcity of level ground. In its industrial life the town is closely allied with Westernport and Luke, both of which are on the Maryland side of the Potomac, the former being just opposite and the latter one mile west of Piedmont, the three communities of nearly equal size being often styled the "tri-towns." In addition to the Baltimore and Ohio Railroad the town is served by the Cumberland and Pennsylvania Railroad, which has its western terminal in Piedmont and thence proceeds up the Georges Creek Valley to Frostburg and thence eastward to Cumberland, and by the Western Maryland Railway which passes through Westernport on the opposite side of the Potomac. Besides these railroads there is trolley connection from Westernport to Lonaconing, Frostburg, and Cumberland. In addition to the railroad business

Piedmont has profited to a material extent from the mining industries of the Georges Creek and upper Potomac Valleys. With the exception of the Potomac Fire Brick Company, which will be described in a later Chapter, it has no manufacturing industries except those of a purely local character and enjoys only a limited amount of country trade.

Ridgeley.

Ridgeley, the third incorporated town of Mineral County in point of size, is located on the south side of the North Branch of the Potomac River at the extreme northern end of the county just opposite the city of Cumberland. According to R. A. Radcliff, Mayor, it was incorporated as a town September 3, 1914, its population by the Census of 1920 being 1,709. It is situated partly on the flood-plain of the river but is partly built on the sharp backbone or slope of Knobly Mountain where this range dies out in the great bend of the river. Being a suburb of Cumberland, although lying in another State, its citizens are chiefly employed in the various industrial and commercial enterprises of the city, but the shops of the Western Maryland Railway, located in Mineral County just southwest of Ridgeley, afford sustenance for a portion of its workers.

Elk Garden.

Elk Garden, the fourth incorporated town in point of size, is located in the western end of the county in a natural amphitheater on the high plateau lands between the North Branch of Potomac River and the Allegheny Front, its principal portion having an elevation of approximately 2,275 feet above sea-level. According to a report from the mayor, it was incorporated as a town January 14, 1890. In 1900 it had a population of 581, in 1910 it had 438, and in 1920 it had 422. It is served by the Elk Garden Branch of the Western Maryland Railway, having connection with the main line at Harrison, and affording general freight and passenger service. As indicated by the population the town is on a slow decline, its busiest period having been about the year 1895 when the mining of the Pittsburgh, or "Big Vein," Coal, which crops within its boundaries and in the surrounding hills, was at its height.

Villages.

Besides the four incorporated towns already described in detail there are numerous mining and residential villages

scattered throughout the county, of which the following list gives the more important ones, exclusive of post-offices having only one or two families, their populations being counted or closely estimated by postmasters or other reliable parties, mining towns being printed in black-faced type:

Mineral County Villages.

Village.	Population 1921	Village.	Population 1921
Alaska (Frankfort) (a)	170	**Nethken (a)**	177
Antioch (a)	54	Newcreek (a)	96
Barnum (e)	200	**Oakmont (e)**	230
Blaine (e)	600	Pattersons Creek (e)	140
Burlington (a)	163	**Potomac Manor (e)**	500
Emoryville (e)	150	Reeses Mill (e)	17
Gleason (e)	500	Russelldale (a)	48
Headsville (e)	231	**Schell (a)**	50
Hubbard (e)	150	**Shaw (e)**	240

(a), Actual count; (e), Estimate.

GENERAL DESCRIPTION, GRANT COUNTY.

MISCELLANEOUS ITEMS.

Formation.—Grant County, comprising the southwestern portion of the area treated in this Report, and named in honor of General U. S. Grant, was formed from Hardy County by Act of the West Virginia Legislature passed February 14, 1866, as follows:

"Be it enacted by the Legislature of West Virginia:

"1. So much of the county of Hardy as is included within the following boundary lines, to-wit: Beginning at Fairfax Stone, at the junction of the line between West Virginia and Maryland, corner to said county of Hardy, and with the said boundary line down the north branch of the Potomac to the Hampshire (now Mineral) and Hardy county line; then with the said line southeastward crossing Patterson's Creek mountain, and thence running the division line between the proposed new county and Hardy county, southward along the top of mountain to the gap below the mouth of Luney's creek, thence with a straight line to the top of Elkhorn Rock, thence along the top of the mountain range which divides the waters of south Mill creek from those of the South Fork to the Hardy and Pendleton county line, thence, with the latter northwestward to the Hardy and Tucker County lines, and with latter to the beginning, shall form one distinct and new county, which shall be called and known by the name of Grant County."

Area.—The present area of Grant County, as determined

with planimeter by R. C. Tucker from the topographic sheets of the United States Geological Survey, is as follows:

Districts.	Square Miles.
Grant	119.65
Milroy	151.35
Union	207.00
Total	478.00

Relief.—The surface of Grant County varies in elevation from 850 feet on Patterson Creek at the Mineral Line, 3.7 miles northward from Williamsport, to 4,150 feet at a high knob on Cabin Mountain along the Tucker Line, 4.7 miles southwest of the Stony River Dam, making a total difference of 3,300 feet.

Climate.—The remarks made concerning the climate of Mineral County on page 10 have a close application to that of Grant. In the latter county the zone of high elevation includes all the territory west of the Allegheny Front, taking in the range named and also Cabin Mountain and the high valleys of North Branch of Potomac River and Stony River. In addition to this area the plateau lands along the eastern slope of North Mountain, west of the Smoke Hole Settlement, Cave Mountain east of the same settlement, and South Fork and Patterson Creek Mountains along the eastern edge of the county, all of which are partly devoted to agriculture or fruit culture, may be classed as the colder type of climate where severe winter storms and a comparatively short growing season may be expected. The cultivated lands of the remaining portions of the county have a much milder climate and a consequent difference in the crops that may be raised. The following statistics concerning temperature, precipitation, and snowfall at Bayard, furnished by H. C. Howe, Section Director, United States Weather Bureau, Parkersburg, West Virginia, give the main climatological facts, the observations having been taken by Mr. Solomon Clark, there being no figures available in the South Branch Valley:

Monthly, Annual, and Mean Temperature, in Degrees and Tenths, at Bayard, W. Va.

(Record made by Solomon Clark.)

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Ann.
1902	.....	.....	.....	.....	60.0	62.3	69.0	64.3	59.9	51.2	45.2	29.6	.....
1903	24.8	29.2	45.2	46.4	57.7	59.2	67.2	66.2	58.7	49.6	32.6	22.8	46.6
1904	22.5	24.2	38.4	42.5	56.4	64.4	66.8	65.1	60.8	47.4	35.7	27.4	46.0
1905	22.4	21.2	41.1	46.8	59.5	65.5	68.0	65.4	59.4	48.8	37.3	30.8	47.2
1906	32.9	26.4	31.2	48.0	56.8	66.8	67.4	70.0	63.0	48.0	39.0	33.0	48.6
1907	33.2	25.0	43.2	40.2	54.4	59.4	68.0	64.5	60.7	44.2	36.7	30.2	46.6
1908	25.1	24.8	42.0	50.2	57.0	64.0	69.1	64.9	60.0	49.1	38.7	31.9	48.1
1909	31.5	36.2	34.2	47.7	56.1	67.0	65.2	64.8	58.3	44.8	43.6	23.7	47.8
1910	29.2	28.2	44.3	49.3	54.0	61.8	69.1	65.8	62.6	52.6	32.6	23.0	47.7
1911	33.4	32.8	34.9	43.8	60.6	65.2	68.2	67.9	63.3	51.0	36.0	35.5	49.4
1912	20.4	22.8	36.0	51.7	58.3	61.8	67.4	63.8	63.4	50.2	40.0	33.6	47.4
1913	36.3	28.0	41.7	47.6	55.6	65.4	68.6	65.9	57.6	50.4	41.0	34.2	49.4
1914	31.0	24.0	31.0	47.0	57.0	67.0	67.5	66.6	57.2	51.7	39.2	26.6	47.2
1915	28.4	32.5	28.8	50.0	55.4	61.6	67.4	65.4	61.8	50.8	40.2	27.2	47.5
1916	36.0	26.8	32.5	45.1	60.0	60.0	69.1	66.5	57.2	48.6	39.2	28.2	47.4
1917	28.8	26.1	34.9	46.0	50.8	63.2	67.6	68.2	55.8	42.5	34.3	18.8	44.8
1918	15.6	30.6	40.6	44.2	62.4	62.6	63.2	.....	.....	.....	.....	.....	.....
1919	.....	27.5	39.9	45.2	.....	.....	.....	.....	.....	.....	.....	.....	.....
1920	24.4	.....	38.4	43.3	50.8	63.0	.....	.....	.....	.....	.....	.....	.....
1921	32.6	32.7	48.3	.....	.....	.....	.....	64.6	66.6	49.6	43.9	33.6	.....
Av.	28.2	27.7	38.2	46.4	56.8	63.3	67.6	65.9	60.4	48.9	38.6	28.8	47.4

Precipitation: Monthly, Annual, and Average Amounts, in Inches and Hundredths, at Bayard, W. Va.

(Record made by Solomon Clark.)

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Ann.
1902	.....	.....	.....	.....	2.75	3.75	4.00	2.00	3.00	2.58	2.76	6.21	.....
1903	4.38	6.10	4.20	3.47	3.83	6.13	4.56	2.84	1.71	2.89	1.88	2.26	44.25
1904	3.25	2.74	4.04	3.18	3.80	4.84	4.17	1.71	1.77	2.35	0.88	3.95	36.68
1905	3.38	3.02	4.64	3.02	4.09	3.42	7.38	4.54	1.80	4.08	2.83	2.94	45.14
1906	3.85	2.37	6.95	4.98	2.57	3.95	2.95	6.56	3.77	3.63	2.23	7.51	51.32
1907	9.42	4.17	6.45	3.60	4.42	7.11	7.55	4.60	4.75	3.82	4.82	4.11	64.82
1908	4.71	5.07	6.08	5.26	9.85	2.68	5.73	2.77	0.47	1.34	0.96	3.65	48.57
1909	4.09	3.30	3.72	5.09	3.55	6.51	2.95	4.96	4.69	4.88	1.38	3.74	48.86
1910	7.18	3.02	0.71	3.17	3.20	7.11	2.80	1.21	2.24	2.00	2.72	3.81	39.17
1911	7.62	2.38	4.29	5.20	2.71	6.65	3.18	10.85	4.97	5.05	2.76	4.32	59.98
1912	3.41	3.50	6.74	3.21	3.97	4.65	8.44	4.43	5.98	1.42	2.86	3.50	52 11
1913	6.21	2.07	3.39	3.54	7.90	4.05	7.21	5.51	3.68	7.75	6.31	2.64	60.26
1914	5.65	3.89	3.70	6.86	1.66	4.96	5.46	6.04	2.13	2.20	1.83	6.08	50.46
1915	5.20	3.14	1.91	2.26	6.22	5.04	3.55	6.87	3.79	3.69	2.85	3.75	48.27
1916	5.39	4.48	5.44	4.16	4.60	5.14	4.17	4.96	6.14	3.46	1.62	3.18	52.74
1917	6.39	2.95	4.33	3.04	5.10	2.64	4.95	3.85	3.78	3.56	0.64	0.79	42.02
1918	2.00	4.34	5.57	4.55	4.10	3.71	4.73	.....	.....	.....	.....	.....	.....
1919	.....	1.98	.....	1.03	.....	.....	.....	.....	.....	.....	.....	.....	.....
1920	3.02	.....	3.47	4.46	1.57	4.65	.....	.....	.....	.....	.....	.....	.....
1921	.....	3.16	3.44	.....	.....	.....	.....	.....	5.20	2.62	6.24	5.04	.....
Av.	5.01	3.43	4.39	3.89	4.22	4.83	4.93	4.61	3.52	3.37	2.68	3.97	48.85

Monthly, Annual, and Average Snowfall, in Inches and Tenths, at Bayard, W. Va.

(Record made by Solomon Clark.)

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Ann.
1902	.....	.....	.....	.....	.....	.....	.....	.....	.....	T	2.5	15.8	.....
1903	6.5	4.0	1.0	T	T	.....	.....	.....	.....	T	4.3	.....	.....
1904	.....	.....	.....	1.0	.....	.....	.....	.....	.....	0.5	1.2	16.1	.....
1905	33.8	26.4	.....	11.0	.....	.....	.....	.....	.....	1.0	2.0	10.0	.....
1906	7.7	18.8	22.5	3.0	T	.....	.....	.....	.....	9.0	9.0	13.0	83.0
1907	12.0	27.0	21.0	16.0	T	.....	.....	.....	.....	T	8.0	18.5	102.5
1908	37.5	39.4	2.0	3.0	1.0	.....	.....	.....	.....	.....	7.5	9.5	99.9
1909	17.0	11.2	18.1	10.0	2.0	.....	.....	.....	.....	0.1	1.0	23.2	82.6
1910	32.0	16.0	4.0	7.0	T	T	.....	.....	.....	1.6	14.5	32.2	107.3
1911	6.0	11.0	20.5	18.2	T	.....	.....	.....	.....	.....	8.8	5.5	70.0
1912	24.5	12.0	6.5	0.4	T	.....	.....	.....	.....	T	2.6	15.5	61.5
1913	20.5	8.0	9.5	2.0	.....	.....	.....	.....	.....	T	7.0	0.5	47.5
1914	4.2	9.8	12.5	T	.....	.....	.....	.....	.....	0.5	2.0	19.8	48.8
1915	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
1916	11.2	16.8	12.2	14.5	T	.....	.....	.....	.....	T	3.2	17.0	74.9
1917	7.4	28.5	22.5	12.0	0.2	.....	.....	.....	.....	14.0	3.5	13.8	101.9
1918	41.8	5.5	2.5	24.5	0.5	.....	.....	.....	.....	.....	.....	.....	.....
1919	.....	16.5	.....	5.0	.....	.....	.....	.....	.....	.....	.....	.....	.....
1920	13.2	.....	17.5	11.0	.....	.....	.....	.....	.....	.....	.....	.....	.....
1921	.....	23.0	T	.....	.....	.....	.....	.....	.....	0.5	2.0	1.9	.....
Av.	18.3	17.1	11.5	8.2	0.3	T	.....	.....	.....	2.0	4.9	14.2	76.5

Population.—The following table, taken from the United States Census returns for 1920, shows the population of Grant County for the last three enumerations:

Population of Grant County.

Minor Civil Division	1920.	1910.	1900.
Grant District	1,918	1,896	1,901
Milroy District, including Petersburg town	3,584	2,675	2,471
Petersburg town	834	.....	.....
Union District, including Bayard town	3,491	3,267	2,903
Bayard town	1,074	417	540
Totals for County	8,993	7,838	7,275

For the period covered by the returns there is an increase in population of only 23.6 per cent., as compared to 54.1 per cent. for Mineral County, and 52.7 per cent. for the entire State during the same interval. In density of population the county has only 18.8 inhabitants per square mile, as compared to 60.1 per mile for Mineral County and 59.8 per mile for the entire State.

Products.—The principal animal products are cattle, horses, sheep, poultry, hogs, mules, and bees, their value being in the order named.

The principal agricultural products and fruits are corn, wheat, oats, potatoes, hay, rye, buckwheat, barley, apples, peaches, cherries, pears, grapes, and plums, their relative value being uncertain. The remarks made on page 14 concerning the cultivation of fruits on the chert lands of Mineral County apply to a less extent in Grant, their long distance from main line transportation having retarded their development.

The principal mineral and manufactured products now in a development stage are coal, lumber, leather, limestone, and brick. Pig iron was once manufactured in the county but there are no furnaces in operation at present.

Property Valuation.—According to Hon. John C. Bond, State Auditor, the following table shows the property valuation for Grant County for three years, the figures for 1922 being by Mr. M. S. Judy, Clerk of the County Court of Grant County:

	1919	1920	1921	1922
Real Estate	$3,871,196	$3,962,528	$4,229,435	$4,673,610
Personal Property	2,400,131	2,611,178	2,930,171	2,564,865
Public Service Corporations	592,063	568,266	540,273	623,617
Totals	$6,863,390	$7,141,972	$7,699,879	$7,862,092

A comparison of the above figures with those for other counties in the Auditor's Report for 1921, the last year in which complete returns are available, shows that Grant ranks 52nd in point of wealth in the State. On account of a radical revision of property assessments in 1921 there is a heavy increase in valuation for that year that does not correspond to any unusual economic development.

Postal Service.—Grant County is served partly by railway mail and partly by star route and rural free delivery carriers. City or village delivery is not afforded in any of the towns. The following table, compiled from the United States Official Postal Guide, shows the number of post-offices in the county, the only rural free delivery route being indicated by a figure following the office of its source:

Arthur	Henry	Mount Storm
Bayard	Jordanrun	Pansy
Bismarck	Lahmansville	Petersburg
Dorcas	Landes	Rough Run
Falls	Martin	Scherr
Forman	Masonville	Streby
Gormania—1	Maysville	Williamsport
Greenland	Medley	Wilson.

TOWNS AND INDUSTRIES.

Petersburg.

Petersburg, the county-seat of Grant, is located in the southeastern part of the county, being mainly on the north side of the South Branch of Potomac River and built partly on the flood-plain and partly on the terrace lands of the river, with an elevation of 937 feet above sea on the lower level. According to R. W. Baker, Mayor, it was named in honor of the Peters family, being first known as Peterstown and later Petersburg, and was incorporated as a town in 1910. Its early history much antedates its incorporation but its growth was extremely slow until the Hampshire Southern (now Baltimore and Ohio) Railroad, which serves it, was built to this point in 1911. Since that time its expansion has been comparatively rapid, many beautiful homes as well as business and public buildings having been completed within the past two years. Situated in the broad valley of the South Branch, and having in full view Patterson Creek, Knobly, New Creek, North, and Cave Mountains, and with the jagged crest of Elkhorn visible from near-by points, and having wide, shady streets and an unusually large number of neat and pleasing homes, Petersburg greets the newcomer with an altogether delightful sense of beauty and comfort.

In its commercial phase Petersburg profits by having most of the county offices and by being the supply point for most of the county east of the Allegheny Front as well as the larger portion of Pendleton County. Industrially it has a large tannery and a brick plant. Educational facilities are afforded by a graded and high school and by a denominational school of secondary rank.

Although being the present county-seat, Petersburg has not always enjoyed this honor, having alternated in this particular with Maysville, which was the first county-seat and which still retains the county jail, although distant eleven miles from the court-house. The history of the two towns in this connection, described as follows by Dr. J. M. Callahan in his Semi-Centennial History of West Virginia, page 162, is most interesting:

"In Grant county, conditions, similar to those which caused its formation in 1866, also produced a series of county-seat contests. The county-seat was first at Maysville. Until the court-house was completed at Maysville in 1866, court was held in an old building at Laurelton, about one mile west of Maysville. About 1870, the question of removal of the county-seat was submitted to a popular vote at a special election. The result was in favor of Petersburg. The legislature of 1872-73 passed an act which made a three-fifths

vote necessary for the removal of the court-house. In 1876, at the general election, the question was submitted again to popular vote, Maysville obtained a majority of the votes but not the necessary three-fifths. About 1880 the question was submitted again and was decided in favor of Maysville, but a dispute arose in regard to the technical legality of the election, resulting in a decision against its legality by the supreme court. In 1895 Hon. A. C. Scherr, together with F. M. Reynolds (a member of the legislature from Mineral county) and the representative from Grant county, prepared a special bill which became a law, requiring only a majority vote for the removal of any county-seat which had been moved prior to the year 1872. As a result of this act, designed to apply only to Grant county, the county court immediately ordered an election which gave Maysville a majority vote, resulting in the removal of the county-seat. Judge Armstrong of the circuit court then decided that the bill of 1895 was unconstitutional, and the supreme court confirmed the decision. Thereupon Petersburg again became the county-seat."

Union Tanning Company.—The Union Tanning Company, with head offices at 17 Battery Place, New York City, operates a tannery just west of the mouth of Lunice Creek at the eastern edge of Petersburg, the plant having been acquired about 1910 from Ingram and Taylor. According to A. Crippen, Superintendent, this concern manufactures soleleather, its capacity being 100 hides daily, the product going to the general trade. Oak bark from the local forests is used in the tanning process. Fifty men are employed, of whom 10 are skilled laborers.

M. M. Hatch Brick Plant.—The M. M. Hatch Brick Plant, located at Petersburg, will be described in Chapter XX, under the subject of "Clays and Clay Industry."

Bayard.

Bayard, located on the south side of the North Branch of Potomac River along the northwestern edge of the county, and having an elevation of 2,356 feet above sea, by the levels of the main line of the Western Maryland Railway which passes through it, was incorporated as a town in 1893, according to G. T. Plummer, Mayor, its name having been received from United States Senator Bayard, who was interested in the construction of the railroad. By the Census returns it had a population of 540 in 1900, 417 in 1910, but in 1920 it had increased to 1,074, a large influx of people having occurred within the past few years, due to unusual activity in the mining industry. Aside from a small lumber plant, operating on the waters of Buffalo Creek, the town is mainly supported by the coal mining industry, a description of which will be found in Chapter XVII.

Villages.

Besides the two incorporated towns already described in detail, there are numerous mining and residential villages scattered throughout the county, of which the following list gives the more important ones, exclusive of post-offices having only one or two families, their populations being counted or closely estimated by postmasters or other reliable parties, mining towns being printed in black-faced type:

Grant County Villages.

Village.	Population 1921.	Village.	Population 1921.
Dobbin (e)	75	Medley (a)	41
Gormania (e)	**400**	Mount Storm (a)	37
Henry (e)	**250**	Pansy (a)	16
Lahmansville (e)	40	Scherr (e)	35
Masonville (e)	40	Williamsport (a)	25
Maysville (a)	115		

(a), Actual count; (e), Estimate.

CHAPTER II.

PHYSIOGRAPHY.

PHYSIOGRAPHIC CHANGES.

EVOLUTION OF MOUNTAIN FORMS.

The present land-forms of Mineral and Grant Counties are the results of many complex forces that have acted through successive ages of geologic history. The surface rocks consist entirely of stratified layers of sandstone, shale, limestone, coal, and occasional bands of iron ore, all of which, with the exception of coal, were deposited under a considerable depth of water. The various coal beds naturally had their origin at a time when flat, swampy conditions prevailed over comparatively wide areas, the water being shallow enough to permit plant growth, at the same time being deep enough to preserve mature vegetation from decay by oxidation. The occurrence of all this stratified material presupposes and requires that there must have been wide areas over which comparatively level conditions prevailed. The present forms show that many changes have taken place since the time of the ancient, subaqueous plains. In a large portion of the area, particularly east of the Allegheny Front, the rocks are no longer in a horizontal position, but have been warped into great arches and troughs by lateral and other forces due to the cooling of the earth's crust and to extensive anomalies of gravity that occurred. In addition to these great structural changes that have taken place from time to time, and that have at times elevated wide areas of land above the level of the ancient Appalachian Sea, the surface has been eroded and cut into great hollows by the action of rainwater, the effect of which began when land first appeared and which still continues at the present time. It is clear, therefore, that two great agencies were concerned in the development of the present mountain forms, the first being

the forces of lateral thrust and uplift which formed them, and the second being the force of erosion which tends to tear them down.

Previous geological work by many investigators has shown that the first folding which formed the Appalachian System, in which the two counties are located, took place at the close of the Permian Period. There are no rocks of this type now left in the area but they still exist in Garrett and Allegany Counties, Maryland, immediately northward, and in other counties of West Virginia farther westward, and it is reasonable to believe that they once covered portions, or possibly all, of the two counties. If it is assumed that only a nominal amount of these rocks existed, a restoration of all the intervening strata down to the Silurian deposits which now form the crests of several of the high ridges in central and eastern Mineral and Grant Counties would call for mountain heights in some cases 16,000 to 17,000 feet above their present levels, an illustration being the New Creek Mountain of northern Grant County, now capped mainly by White Medina Sandstone, with summits 2,500 to 3,000 feet above sea-level. If the ancient rocks were all restored this ridge would reach a height of 18,000 to 20,000 feet above the sea. Erosive action took place, however, at the same time as the lateral folding and it would be mere conjecture to say what height this mountain actually attained.

The erosive action of mountain streams, begun in the Permian Period, continued through many thousands, or perhaps millions, of years, until at the end of the Triassic Period, as now believed, the Appalachian summits had reached an almost level, or peneplain, condition, sloping gently westward toward the Mississippi Basin, broken only by occasional pinnacles of the more resistant rocks.

During the late Jurassic Period lateral forces again became active and raised the peneplain into a second mountain system, exposing still deeper formations of the rock column, which were attacked again by the rains of the Cretaceous Period, bringing them down to a second peneplain.

In the late Cretaceous or early Tertiary Period another series of foldings created a third range of mountains located in the same region as the two previous ones, followed by subsequent erosion. A further cycle of uplift took place in late Tertiary time making a fourth range of mountains, this latter range, or series of ranges, composing the Appalachian System of the present day. The present geological period

being one of erosion, the mountains, for the fourth time, are wearing down to a lower level.[1]

In their geographic relations Mineral and Grant Counties belong partly in the Cumberland Plateau, or Western Division, and partly in the Appalachian Valley, or Central Division, of the Appalachian Province, a general description of which may be found in various publications.[2]

A more recent publication by Abbe[3] divides the Appalachian Province into four subdivisions, named from east to west the Blue Ridge, the Great Valley, the Allegheny Ridges, and the Allegheny Plateau. These four subdivisions were named to apply to the physiography of Maryland but the same forms extend into West Virginia. Inasmuch as the former nomenclature could easily be confusing when applied to Mineral and Grant Counties, since the name of Cumberland Plateau is derived from the Cumberland River in Tennessee and does not apply to the city of Cumberland, which is not in the plateau region, the classification of Mr. Abbe will be followed.

The Blue Ridge subdivision includes the Blue Ridge and Catoctin Mountains and intervening territory. The Great Valley subdivision consists of the low-lying limestone lands from the Blue Ridge west to North Mountain, Berkeley County. The Allegheny Ridges subdivision extends westward to the Allegheny Front. The Allegheny Plateau subdivision includes all the area from the Allegheny Front westward to the limits of the Appalachian Province.

It is evident from the above descriptions that those portions of Mineral and Grant Counties lying west of the Allegheny Front fall into the Allegheny Plateau subdivision while the remainder is in the region of the Allegheny Ridges, where sharp, narrow structural features of less height than the plateau are much in evidence.

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[1]A recent publication by E. W. Shaw (Ages of Peneplains of the Appalachian Province, Bulletin, Geological Society of America, Volume 29, No. 3, Sept., 1918) disputes the conclusion that any of these peneplains could have been formed at such an early period and still remain in existence over the wide areas they cover, the opinion being expressed that none of them is earlier than Tertiary or perhaps mid-Tertiary time.

[2]See Darton and Taff, Piedmont Folio, No. 28, United States Geological Survey; 1895.

[3]Cleveland Abbe, Jr., Maryland Weather Service, Volume I, p. 120; 1899

PENEPLAINS.

Schooley Peneplain.

The Schooley Peneplain, named by W. M. Davis from its occurrence on Schooley Mountain, Morris County, New Jersey, is by far the most important and long continued of all the ancient plains of the Appalachian Province. Believed by many to have been developed during the Cretaceous Period the statement is made by Abbe[4] that Triassic sediments occur at its type locality while in other regions Jurassic rocks have been deposited on it, indicating that it should be attributed to Jurassic time, in contrast to the earlier belief, which appears to have been based on a mistaken correlation. As previously mentioned, page 30, Shaw disputes the idea that this peneplain could have been formed even so early as the Cretaceous Period. Remnants of this great plain, much warped by later folding and often cut into mere ribbons by stream erosion, still exist from the Coastal Plain westward to the Ohio River and beyond.

In Mineral and Grant Counties the Schooley Peneplain is best represented in the Allegheny Plateau Region west of the Allegheny Front where its ancient level, now rendered uneven by folding, may be traced by eye for long distances. Along the rim of the Allegheny Front and Cabin Mountain its ancient surface has elevations that at some points reach more than 4,000 feet, while in the North Potomac and Stony River Basins it dips to a lower level. In the Allegheny Ridges subdivision it is probable that the high backbone of New Creek Mountain at several points, starting northeast of Laurel Dale, Mineral County, and continuing southward toward North Fork Gap, with elevations from 2,550 to 3,100 feet, may be remnants. On Patterson Creek Mountain in Grant County the high summit at the corner of this county with Mineral, Hampshire, and Hardy, with an elevation of 2,750 feet, and Huckleberry Ridge and several other flat summits southward as far as Charles Knob, with the same elevations, seem to represent it.

Weverton Peneplain.

The Weverton Peneplain, named from Weverton, Washington County, Maryland, and classified by members of the Survey of that State as being of late Jurassic or possibly early Cretaceous age, and having a general elevation of 400 to 500 feet less than the Schooley, has been quite definitely traced

[4]Maryland Weather Service, Volume I, pp. 120-121; 1899.

from the western edge of the Coastal Plains through the Piedmont, Blue Ridge, and Great Valley areas into the Allegheny Ridges subdivision in the vicinity of Cumberland. From this point southward through Mineral and Grant Counties it seems to be represented by the summit of Patterson Creek Mountain northwest of Romney with an elevation of 1,650-1,700 feet, by a broad shelf on the same mountain south of Charles Knob with an elevation of 1,850-1,900 feet, by numerous summits of Knobly Mountain with elevations ranging from 1,700 feet in northern Mineral to 1,800 feet or more in central Grant, by Dolls Gap in New Creek Mountain east of Laurel Dale, Mineral County, with an elevation of 2,033 feet, by another gap in the same range northeast of Streby, Grant County, with an elevation of 2,100 feet, by the Fore Knobs along the east slope of the Allegheny Front with elevations ranging from 2,400 feet in the vicinity of Keyser to 2,800 feet near the Pendleton County Line, and by the ridge of Cave Mountain west of Pansy, Grant County, with an elevation of 2,300 feet. In the region west of the Allegheny Front it is possible that the comparatively smooth plateau land lying from 2 to 4 miles southeast of and parallel to the North Branch of Potomac River may belong at the Weverton level, but it seems more probable that the old Schooley Plain has been generally depressed through this synclinal area.

Harrisburg Peneplain.

The Harrisburg Peneplain, named from Harrisburg, Dauphin County, Pennsylvania, and believed to be of early Tertiary age, since deposits of supposed late Tertiary rocks have been found resting upon it, and having a general elevation of 400 feet less than the Weverton and 900 to 1,000 feet less than the Schooley, has been traced from the western edge of the Coastal Plains into the region of the Allegheny Ridges near Cumberland. From this point southward through Mineral and Grant its apparent remnants occur in the Patterson Creek Ridge southeast of Patterson Creek Station with an elevation of 1,200 feet, in a low ridge southeast of Petersburg and southwest of Welton with an elevation of 1,600 to 1,650 feet, in Walker Ridge west of Greenland Gap where for several miles there is a series of flat tops quite noticeable with elevations of 2,000 to 2,200 feet, in the plateau lands near the common sources of Long and Redman Runs of the South Branch of Potomac west of the Smoke Hole Settlement with an elevation of 2,100 feet, and in a long series of secondary knobs of Catskill age on the east slope of the Allegheny Front

Photo by E. E. HARRIS.

PLATE III.—View from Queens Point north of Keyser, looking west through gap made by North Branch of Potomac River between the Allegheny Front (on left) and Dans Mountain (on right) toward Big Savage Mountain in extreme background. Oriskany Sandstone in foreground. Topography ranges from Monongahela to Oriskany Series.

with elevations ranging from 1,850 feet near Keyser to 2,400 feet near the Pendleton County Line.

In the region west of the Allegheny Front no certain correlation of the Harrisburg Peneplain seems possible.

Somerville Peneplain.

The Somerville Peneplain, so named from its occurrence near Somerville, Somerset County, New Jersey, believed to be of late Tertiary age, and having a general elevation of only about 100 feet less than the Harrisburg, has been traced from the Piedmont Plateau Province westward to Cumberland, with a gradual ascent in elevation similar to the three others previously described. From Cumberland southward into Mineral and Grant it seems to be represented by the wide belt of low Chemung and Portage hills that lie between Knobly and Patterson Creek Mountains, with elevations ranging from 1,200 feet at the northern end of Mineral to 1,600 feet in Grant northwest of Petersburg, and possibly by the general depression between Knobly and New Creek Mountains with elevations varying from about 1,200 feet near Keyser to 2,000 feet in the region northeast of North Fork Gap. West of New Creek Mountain no remnants of this old plain are apparent.

RIVER TERRACES.

Evidence of former drainage levels higher than the present channels of the North and South Branches of the Potomac River and their principal tributaries, is abundant. The following table gives in condensed form the locations and other data concerning the terrace deposits of the two branches and their affluents, starting with the main Potomac just below their junction, and passing up the North and South Branches with tributaries in regular order:

Terrace Deposits Along Potomac River and Tributaries.

STREAM AND LOCALITY.	EVIDENCE.	Elevation. Top.	Height of Top Above Stream.	Name of Terrace.
Main Potomac below Junction of North and South Branches:				
French Station (South Branch P. O.), southwest of	Boulders, clay, and gravel	615	95	Third
French Station (South Branch P. O.), 0.6 mile west of	Boulders	645	125	Fourth
French Station (South Branch P. O.), 0.6 mile west of	Rounded point	745	225	Sixth
French Station (South Branch P. O.), 0.6 mile southwest of	Flat top of ridge	840	320	Seventh
North Branch below Patterson Creek:				
Green Spring, 1.3 miles east of	Clay	565	30	First
Green Spring, 1.3 miles east of	Boulders and gravel	595	60	Second
Green Spring	Clay and gravel	560	20	First
Oldtown, Maryland	Clay and gravel	615	75	Second
Hill, 1.1 miles west of Oldtown	Boulders	670	125	Third
Hill, 1.2 miles west of Oldtown	Clay and gravel	625	80	Second
Western Maryland Railway, 0.8 mile east of Round Bottom	Boulders and gravel	615	70	Second
Western Maryland Railway, 0.4 mile northwest of Sloan	Clay and gravel	590	40	First
Spring Gap, 0.2 mile southeast of	Sand and boulders	660	105	Third
Spring Gap, 0.6 mile southwest of	Boulders	600	45	First
Patterson Creek:				
Road fork north of Davis School	Clay and gravel	650	50	First
Road, 0.7 mile southwest of Champwood	Clay and gravel	750	125	Third
Johnson Run, 0.2 mile southwest of mouth	Gravel	760	60	First
North Branch between Patterson Creek and Cumberland:				
Road, 1 mile north of North Branch (Baltimore & Ohio) Sta.	Clay and gravel	765	185	Fifth
Western Maryland Railway, 1 mile northwest of North Branch (Baltimore & Ohio) Station	Sand and boulders	660	80	Second
Sloan-Pound Farm, 1.5 miles southeast of South Cumberland	Sand and gravel	645	65	First

Terrace Deposits along Potomac River and Tributaries.—(Continued).

STREAM AND LOCALITY.	EVIDENCE.	Elevation. Top.	Height of Top Above Stream.	Name of Terrace.
Sloan-Pound Farm, 1.5 miles southeast of South Cumberland	Sand and gravel	690	110	Third
Road, 0.6 mile northwest of mouth of Evitts Creek	Sand and gravel	725	135	Third
Road, 0.9 mile northwest of mouth of Evitts Creek	Sand and gravel	800	210	Fifth
Hill over north end of Western Maryland Railway tunnel, 0.5 mile southeast of South Cumberland	Boulders	750	155	Fourth
Gap, 0.8 mile south of Wiley Ford Bridge	Boulders	705	115	Third
North Branch near Mouth of Wills Creek (Cumberland):				
North side of Wills Creek, 0.8 mile northwest of Baltimore & Ohio Station	Boulders	670	50	First
Point west of mouth of Wills Creek	Rounded bench	660	50	First
Point west of mouth of Wills Creek	Round-topped ridge, well defined	695	85	Second
Point west of mouth of Wills Creek	Gravel and boulders	730	120	Third
Point west of mouth of Wills Creek	Boulders	770	160	Fourth
Point west of mouth of Wills Creek	Rounded top of ridge	795	185	Fifth
Dingle Summit, 1.4 miles west of mouth of Wills Creek	Rounded gap, clay, and gravel	840	230	Sixth
North Branch between Cumberland and Keyser:				
Road, 0.4 mile northeast of Amcelle	Sand and gravel	760	130	Third
Seymour, 0.3 mile northeast of	Clay and gravel	705	70	Second
Seymour, 0.2 mile south of	Topographic shoulder	715	85	Second
Seymour, 0.3 mile southeast of	Topographic shoulder	850	220	Sixth
Road, 0.7 mile southwest of Cresaptown	Sand and gravel	860	220	Sixth
Road, 0.5 mile north of Frost	Large boulders	765	105	Third
Road, 0.5 mile west of Frost	Boulders	750	90	Second

Terrace Deposits along Potomac River and Tributaries.—(Continued).

STREAM AND LOCALITY.	EVIDENCE.	Elevation. Top.	Height of Top Above Stream.	Name of Terrace.
Road, 0.4 mile west of Bier	Boulders	795	125	Third
Road, 0.2 mile northwest of Rawlings	Boulders	750	75	Second
Head of Mill Creek, 3.1 miles southwest of Rawlings	Large boulders in rounded gap	1090	390	Seventh
Road, 0.5 mile north of Dawson	Sand and gravel	780	55	First
Road, 1.1 miles southwest of Dawson	Sand and gravel	825	75	Second
Point, 0.2 mile northeast of 21st Bridge	Sand and gravel	880	110	Third
Gap, 0.3 mile southeast of 21st Bridge	Sand and gravel	915	145	Fourth
North Branch, vicinity of Keyser:				
Low gap, 0.4 mile northeast of McCool	Boulders	1005	215	Fifth
Low ridge, 0.7 mile northwest of McCool	Boulders	990	190	Fifth
Potomac State School grounds	Boulders	960	160	Fourth
North Branch between Keyser and Piedmont:				
Road, 2.5 miles southeast of Piedmont	Boulders	965	125	Third
North Branch, vicinity of Piedmont:				
Oakview, east edge of Westernport	Boulders	1020	120	Third
Hill, east of Westernport	Boulders	1100	200	Fifth
Hill, east of Westernport	Flat shoulder	1340	440	Seventh
Hill, east of Westernport	Flat shoulder	1550	650	Ninth
Hill, east of Westernport	Smooth ridge top	1725	825	Tenth
Franklin Hill, northeast of Luke	Single round boulder	1455	530	Eighth
Luke, northwest edge of	Boulders	1110	150	Fourth
Top of quarry at Bloomington	Boulders	1030	40	First
Point between Potomac and Savage Rivers west of Bloomington	Boulders	1110	120	Third

Terrace Deposits along Potomac River and Tributaries.—(Concluded).

STREAM AND LOCALITY.	EVIDENCE.	Elevation. Top.	Height of Top Above Stream.	Name of Terrace.
South Branch between mouth and Romney:				
Low ridge, 0.4 mile southeast of Springfield	Boulders	735	170	Fifth
Low divide, 1 mile northwest of Wapocomo	Rounded gap	795	175	Fifth
Romney town site	Boulders and gravel	820	170	Fifth
South Branch between Romney and Moorefield:				
Road at Old Fields	Boulders and gravel	810	60	Second
Thrasher Spring School, 3.8 miles northwest of Old Fields	Rounded point	1200	450	Seventh
Road, 0.8 mile northwest of Cunningham	Gravel	810	28	First
South Branch between Moorefield and Petersburg:				
Road, 0.2 mile west of Fisher	Boulders and gravel	900	90	Second
Low point, 1 mile southeast of Riverside School	Clay and sand	980	145	Third
Field, 0.4 mile west of Durgon	Boulders	930	75	Second
Road, 1 mile west of Durgon	Boulders	1000	140	Third
South Branch, vicinity of Petersburg:				
Road fork, 0.5 mile east of Fort Hill	Boulders and gravel	1025	100	Second
High School grounds	Clay	965	40	First
Point, 0.4 mile southwest of Baltimore & Ohio Station	Boulders	1065	140	Third
Point, 0.4 mile southeast of Baltimore & Ohio Station	Sand and gravel	1070	145	Third
Hill, 0.4 mile south of Baltimore & Ohio Station	Boulders	1125	200	Fifth
Ridge, 0.5 mile northwest of Hiser	Boulders	1165	240	Sixth
Road, 0.8 mile southeast of Hiser	Clay and boulders	1035	110	Third
Road, 0.7 mile southeast of Royal Glen Mill	Boulders	1215	255	Sixth
North Fork of South Branch:				
Road, 1 mile southwest of Corners	Boulders	1120	140	Third
Road, 0.3 mile northeast of mouth of Jordan Run	Boulders	1335	285	Sixth
Road, 0.4 mile north of High Ridge Run, near Pendleton line	Boulders	1530	300	Sixth

Flood-plain levels, Main Potomac: at junction of North and South Branches, 17 feet.

Flood-plain levels, North Branch: at Green Spring, 15 feet; at South Cumberland, 20 feet; at Keyser, 14 feet; at Piedmont, 15 feet; at Barnum, 20 feet; at Gleason, 12 feet.

Flood-plain levels, South Branch: near Cunningham, Hardy County, 12 feet; at Moorefield, 15 feet; at Petersburg, 15 feet.

On the North Branch the entire stream was traversed in the course of general geologic work and terrace observations were taken at frequent points, leaving little doubt as to the occurrence and correlation of the principal terraces. It is worthy of note that few terraces are found on its upper waters above Piedmont, such deposits having been largely removed by the erosive action of the river subsequent to their formation. On the South Branch below Old Fields, Hardy County, only a few observations were taken, but above this point the record is fairly complete to the Pendleton County Line, both on the South Branch proper and on its North Fork. On the South Branch between Royal Glen Mill and the Pendleton Line, where the valley is of a gorge-like character, no terraces were observed. Terrace gravel is abundant in the vicinity of Petersburg, the relationship and correlation of these deposits with those of the North Branch being quite evident.

From this series of observations there appear to be eight, and possibly ten, terraces along the two branches of the Potomac, which may be summarized in descending order as follows:

Summary of Potomac River Terraces.

Tenth Terrace	(?) to 825 feet above the rivers.
Ninth Terrace	(?) to 650 feet above the rivers.
Eighth Terrace	(?) to 530 feet above the rivers.
Seventh Terrace	320 to 450 feet above the rivers.
Sixth Terrace	225 to 300 feet above the rivers.
Fifth Terrace	170 to 210 feet above the rivers.
Fourth Terrace	125 to 160 feet above the rivers.
Third Terrace	95 to 145 feet above the rivers.
Second Terrace	60 to 100 feet above the rivers.
First Terrace	20 to 65 feet above the rivers.

In addition to these terraces the low flood-plain of the river occurs from 10 to 20 feet above the present normal drainage. Typical river wash material was observed at all these levels except at the ninth and tenth terraces which have been included in the summary because of certain smoothly rounded shoulders on Horse Rock Hill just east of Westernport,

Maryland, the same being quite noticeable from the opposite side of the valley. The eighth terrace is correlated on the evidence of a single rounded boulder, five or six inches in diameter and clearly of aqueous origin, found at the edge of the broad plateau, or shoulder, on Franklin Hill northeast of Luke, Maryland. At the horizon of the seventh terrace abundant river-wash was found at several localities, leaving no doubt as to the former presence of flood water at this level. The six lower terraces are all based on the presence of washed material found at various points, and all of them may be observed in the angle between Wills Creek and the North Branch of Potomac at Cumberland.

The correlation of these ten terraces with the more extended physiography of the Appalachian, Piedmont, and Coastal Plain regions can be attempted only after a wide study has been made, preferably by a single observer, as extensive as the territory involved. Dr. Grimsley[5] has suggested that the terrace occurring on the main Potomac near Pawpaw, Morgan County, at an elevation of about 700 feet, may represent the Somerville Peneplain, and that the remnants of another coming at about 1,000 feet in the same region belongs at the level of the Harrisburg Peneplain. If that assumption be true a proper allowance for a gradual ascent toward the headwaters of the two branches would place the sixth terrace of the writer at the Somerville horizon and the ninth or tenth at the Harrisburg level. Such an interpretation would leave one of the upper terraces, the ninth or tenth, in an unknown relationship, and would leave the seventh, which is one of the most important of the upper valleys, and also the eighth, without any equivalent in the physiography of the region farther east. Inasmuch as the Harrisburg and Somerville Peneplains have both been assigned to the Tertiary Period on good authority, the presence of two additional erosive levels in an intermediate position would seem to indicate further cycles of diastrophism within the same period, unless, as an alternative, the seventh and eighth terraces may be wholly ascribed to differential rates of erosion due to the presence of hard rocks across the path of the lower Potomac in the Blue Ridge and Piedmont regions.

The five terraces of the upper Potomac that occur below the supposed level of the Somerville Peneplain are quite clearly of more recent origin than those which may be attributed to the Tertiary Period. The third, fourth, and fifth are probably of Pleistocene age, although wholly disconnected

[5] G. P. Grimsley, Jefferson, Berkeley, and Morgan Report, West Virginia Geological Survey, pp. 53-54; 1916.

with the glacial phenomena responsible for many terraces on more northern rivers to the valleys of which the northern ice-sheet extended. The first and second terraces may be of the same period but more likely belong in the Quaternary, as they are much more extensive and show much less evidence of disintegration. Since these five lower terraces have apparently been influenced neither by diastrophism nor by glacial dams their presence is ascribable to the retarded flow of the Potomac, caused by differential erosion across the alternate layers of hard and soft rocks in its course.

PRESENT TOPOGRAPHIC FEATURES.

REGION WEST OF ALLEGHENY FRONT.

In its general features the topography of that portion of Mineral and Grant Counties west of the Allegheny Front much resembles that of the central and western part of the State, except that the features are larger and the influence of the rock structure is more pronounced. In the long ridges and in many of their lateral branches the remains of the old Schooley Peneplain, of supposed Jurassic age, may still be clearly noted, although the ancient surface has been distorted and rendered uneven by later folding. The North Branch of Potomac River and Stony River, its major affluent in this region, both closely follow structural depressions. The present mountains, however, do not represent axes of uplift, but are located along the sides of anticlines, the softer sediments that were exposed at the ancient crests of the folds having now been eroded to very considerable depths. The two principal ridges of this region, Cabin Mountain on the west and the Allegheny Front on the east, are capped by the hard rocks of the Pottsville (Pennsylvanian) Series, and present a rugged and forbidding appearance, but in the valley of North Branch above Piedmont and in the middle and upper valley of Stony River most of the Pottsville is below drainage and the younger rocks of the Pennsylvanian are indicated by topographic forms that are comparatively more gentle. North Branch has cut a deep channel into these younger sediments and the lower course of Stony River has done the same work to a less degree, but its upper valley is still shallow and quite immature.

In a large part of the two counties west of the Allegheny Front, the topography is rough and boulder-strewn, being unfit for agricultural purposes and much of it even too rough for successful grazing. Along the axis of the North Potomac Syncline, however, where the remaining lower portion of the Monongahela Series and the upper portion of the Conemaugh

contain soft shales, there are arable plateau lands, and along the Stony River Syncline from Bismarck northward to its junction with the North Potomac near Shaw there are also smooth uplands well adapted for short season crops, there being Monongahela rocks exposed in Mineral and Conemaugh rocks in both Mineral and Grant.

REGION EAST OF ALLEGHENY FRONT.

In the region east of the Allegheny Front the topography is highly diversified. Sharp, narrow mountain ridges, cut through at intervals by the transverse gorges made by the minor streams, are readily the most striking features. Between them are often smooth valleys and many intermediate series of low, gentle hills. These many contrasting features are due almost entirely to tectonic agency, followed in turn by differential erosion, the main mountains being anticlinal, almost without exception, and composed of hard rocks which withstand atmospheric and meteoric action, while the intervening valleys and low hills are made by softer or younger rocks that rapidly erode. In the main the major streams lie parallel to the main mountains, notable exceptions being the gap made through the Allegheny Front by North Branch of Potomac River between Piedmont and Keyser, the gap east of Petersburg made through Patterson Creek Mountain by South Branch of Potomac, and that made between New Creek and North Fork Mountains east of Hopeville by the North Fork of South Branch. Elsewhere the principal gaps are made by minor streams from which the inference may be drawn that the positions of the major drainage basins were established as a result of early and somewhat rapid folding, the folds being separated by comparatively wide linear intervals, allowing secondary transverse drainage to be developed; and that the secondary streams preserved their courses and cut gorges across intermediate folds of more recent origin and of less rapid uplift.

New Creek Mountain.—New Creek Mountain, the principal western fold of the region named, extends from Keyser southwestward to North Fork of South Branch, a distance of 35 miles, beyond which it is known as North Fork Mountain and passes into Pendleton County six miles beyond the North Fork Gap. From Keyser to the gap southeast of New Creek village, a distance of eight miles, the mountain is comparatively low and formed by various members of the Lower Devonian and Upper Silurian rocks, but from the gap named southwestward to the Grant-Pendleton County Line and for

many miles beyond it is formed by the highly quartzitic White Medina Sandstone of Lower Silurian age and becomes a bold and forbidding feature entirely unfit for agriculture or even grazing. From Keyser northeastward to Cresaptown, Maryland, 13 miles, the mountain is lost in a comparatively low structural saddle which permits the North Branch of Potomac to cut across it at will and in which the Medina is above drainage in only one locality, but at Cresaptown the Medina rises to great height again, forming Wills Creek Mountain through which Wills Creek cuts a great gorge just northwest of Cumberland, its extent beyond that point being of no further present interest.

Knobly Mountain.—Just southeast of New Creek Mountain and separated from it by an interval that is usually less than two miles, Knobly Mountain extends from Cumberland southwestward to the gap of North Fork of South Branch, a distance of 50 miles, its higher summits being a series of sharp round knobs, from which the mountain derives its name, and which are formed by the Oriskany Sandstone and the Shriver and New Scotland Cherts of the Lower Devonian, all highly resistant in character. In all this distance the mountain is monoclinal in its structure, the beds that form it being on the eastern slope of the great arch that forms New Creek Mountain, and the intervening high, parallel valleys being eroded from calcareous strata. From the gap of North Fork southwestward to the Pendleton County Line, there has not been sufficient erosion in the limestone to form a valley between the outcrops of the Oriskany and Medina Sandstones and for that reason Knobly Mountain does not exist south of North Fork. From Cumberland northeastward the range is continued by Shriver Ridge.

Patterson Creek Mountain.—Patterson Creek Mountain originates at Slate Lick Knob, 3½ miles east of Reeses Mill, Mineral County, and thence extends southwestward, 31 miles, to Charles Knob, 3 miles northeast of Petersburg, where it suddenly dies down completely, giving South Branch of Potomac River an easy passage around its southern end. The river, however, makes a considerable gap through a short, parallel fold about 1½ miles farther east. North of Russelldale, Mineral County, this mountain is formed by the Chemung, Portage, Hamilton, and other series of the Upper and Middle Devonian but south of this point the folding has been more severe, bringing the limestones of the Lower Devonian and Silurian to the surface, the crest of the anti-

cline being in close proximity to the summit of the mountain from Russelldale to Charles Knob.

Cave Mountain.—Cave Mountain, lying south of the South Branch of Potomac and southwest of Petersburg and extending into Pendleton County, would appear from the topographic map to be an extension of Patterson Creek Mountain, but a study of the rock structure of the region reveals that it is a disconnected fold. It is largely of monoclinal structure, the principal arch being at most points one-half mile or more west of the crest of the range. At its northern end it is covered with a wide deposit of Oriskany Sandstone of the Lower Devonian, but farther south the limestones of the Lower Devonian and Silurian come to the surface and form its summit.

Elkhorn and South Fork Mountains.—Elkhorn and South Fork Mountains, which form the southeastern boundary line of Grant with Hardy County, are of mixed structural types. From the Elkhorn Rock, where the White Medina of the Silurian makes a spectacular outcrop, southwestward for three miles the anticline is just west of the summit of the mountain, but at this point the crest of the range veers eastward into a synclinal structure with outcrops of Oriskany Sandstone, while the anticline continues on to the Pendleton County Line in the foot-hills at a distance of about one and one-half miles from the summit.

Middle Mountain.—Middle Mountain, lying between Cave and South Fork Mountains in southern Grant, originates just southwest of Dorcas and extends southwestward into Pendleton County, its southern terminus as a distinct feature being just north of Brushy Fork of North Mill Creek, and its entire length being only about nine miles. It is entirely synclinal in character being capped by the Chemung Series of the Upper Devonian, the softer and more shaly beds of the Portage forming the foot-hills on either side.

DRAINAGE BASINS.

A general view of the drainage system of Mineral County is afforded by Figure 3, and of Grant County by Figure 4, prepared by Mr. Tucker. A comparison of these two figures with Maps I and III in the separate Atlas accompanying this Report well illustrates the previous statement that the major streams, with few exceptions, follow closely parallel to the principal mountain ranges while the minor streams in many cases have cut gorges across them.

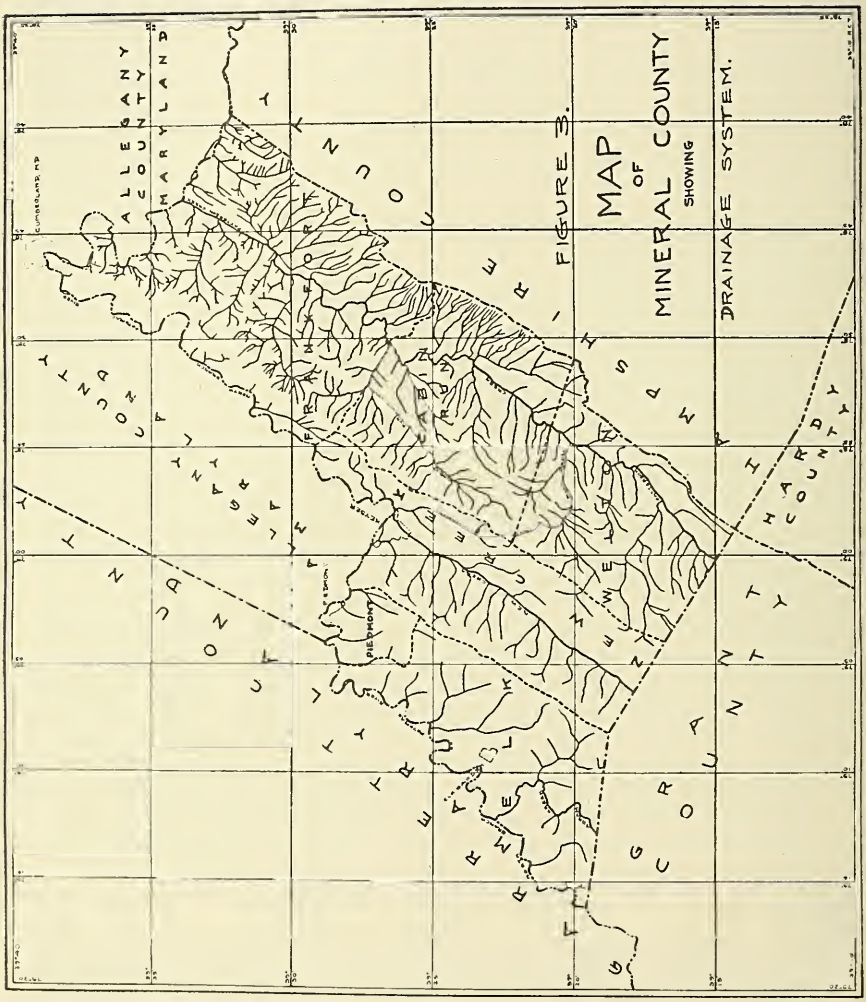
FIGURE 3.
MAP
OF
MINERAL COUNTY
SHOWING
DRAINAGE SYSTEM.
ALLEGANY
COUNTY
MARYLAND
GARRETT
COUNTY
HAMPSHIRE
COUNTY
HARDY
COUNTY
GRANT
COUNTY
PIEDMONT

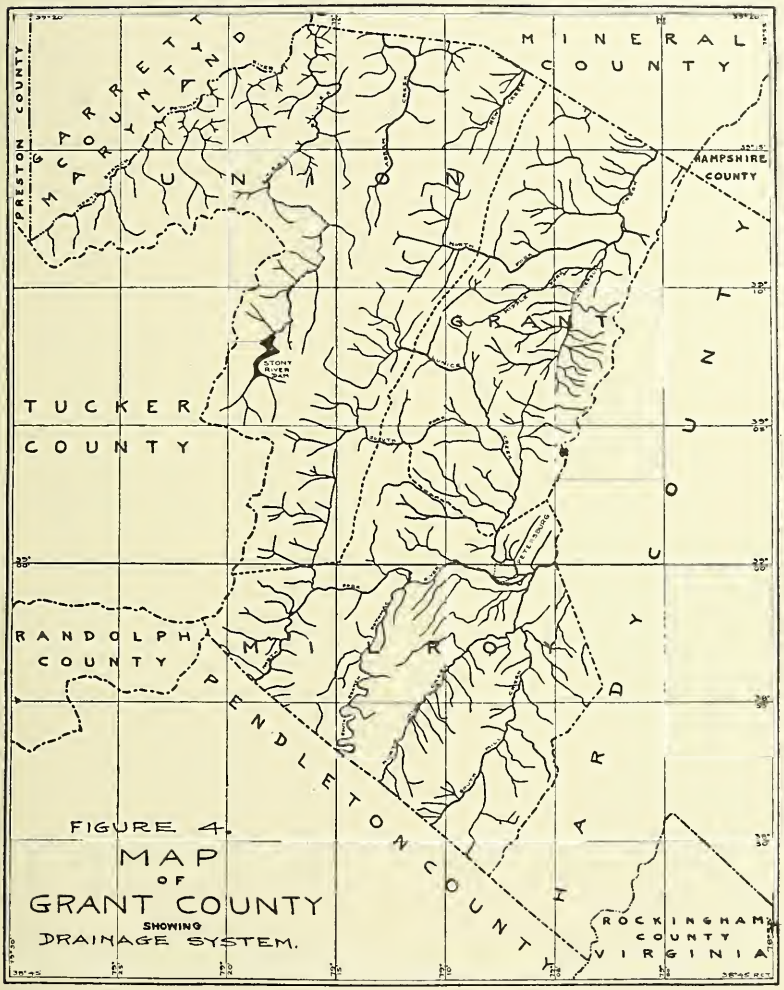

FIGURE 4.

MAP OF GRANT COUNTY SHOWING DRAINAGE SYSTEM.

TABLE OF STREAM DATA.

The following table, prepared by R. C. Tucker, gives a list of the principal streams of Mineral and Grant Counties, the rate of fall and length, both actual stream measurement and air-line distances, being determined. The last column shows the ratio between the total distance (T. D.) and the air-line distance (A. L. D.). Those having the greatest ratio are usually streams that have more nearly reached base-level at some period of their history, while others have apparently preserved more direct courses or lost their ancient meanders:

Table of Stream Data.

Streams	Total Distance. Miles	Total Fall. Feet.	Rate of Fall per Mile. Feet.	Air Line Distance. Miles.	Ratio T. D. to A. L. D.
North Branch Potomac River, source to Hampshire County Line	96.18	2655	27.60	56.23	1.71
Dan Run (Broad Hollow)	3.82	650	170.16	3.75	1.02
Patterson Creek	48.09	900	18.71	37.48	1.28
Rocky Run	4.44	330	74.32	3.75	1.18
Turners Run	5.56	885	159.17	4.14	1.34
Painter Run	4.32	725	167.82	3.90	1.11
Long Pasture Run	3.45	370	107.25	2.95	1.17
Graveyard Run	1.56	205	131.41	1.48	1.05
Mill Run	3.82	805	210.73	3.38	1.13
Kellar Run	3.21	750	233.64	2.81	1.14
Horseshoe Run	3.08	370	120.13	2.07	1.49
Rinehart Run	2.30	825	358.69	2.22	1.04
Sugarcamp Run	2.56	775	302.73	2.30	1.11
Hazel Run	2.71	820	302.58	2.25	1.20
Cabin Run	10.75	360	33.49	8.88	1.21
Purgit Run	3.30	620	187.88	2.71	1.22
Ochre Run	1.95	560	287.18	1.72	1.13
Hollenbeck Run	3.50	755	260.34	2.86	1.22
Dowden Run	2.79	745	267.02	2.58	1.08
Sycamore Run	2.49	690	277.11	2.19	1.14
Beaver Run	5.03	210	41.75	4.60	1.09
Spring Run	2.07	710	343.00	1.87	1.11
Staggs Run	5.52	475	86.05	4.73	1.17
Mikes Run	2.02	315	155.94	1.89	1.07
Johnson Run	2.76	400	144.93	2.43	1.14
Mud Run	1.92	135	70.31	1.70	1.13
Mill Creek	8.73	770	88.20	7.20	1.21
Sugar Run	2.07	300	144.93	1.87	1.11

Table of Stream Data.—(Continued).

Streams.	Total Distance. Miles.	Total Fall. Feet.	Rate of Fall per Mile. Feet.	Air Line Distance. Miles.	Ratio T. D. to A. L. D.
Parrill Run	2.07	345	166.66	1.99	1.04
Liller Run	3.05	610	200.00	2.56	1.19
Wild Meadow Run	3.40	400	117.65	3.16	1.08
Mud Run	1.97	250	125.00	1.90	1.05
Elliber Run	6.21	1490	239.94	5.62	1.10
Mikes Run	7.43	610	82.10	4.93	1.51
Dry Run	2.40	390	162.50	2.17	1.11
Hilkey Run	3.55	520	146.48	2.71	1.31
Whip Run	3.75	415	110.66	3.27	1.15
Cave Run	2.17	1305	601.38	1.88	1.15
Pursley Run	3.18	550	172.96	2.82	1.13
Clints Run	1.87	390	208.56	1.58	1.18
Buskirk Run	2.07	470	227.05	1.82	1.14
Harness Run	2.59	410	158.30	2.20	1.18
Rosser Run	5.77	925	160.31	4.36	1.32
Thorn Run	5.18	830	160.23	4.49	1.15
North Fork	11.15	1070	95.96	9.27	1.20
Elklick Run	3.85	555	144.16	3.14	1.23
Middle Fork	7.45	730	97.99	6.43	1.16
Thorn Run	3.21	260	81.00	3.00	1.07
Ashcabin Run	4.19	800	190.93	4.04	1.04
Limestone Run	4.83	710	147.00	4.42	1.09
New Creek	17.66	1200	67.95	16.57	1.07
Stony Run	2.76	1195	432.97	2.27	1.22
Parr Spring Run	2.37	880	371.31	2.23	1.06
Block Run	3.40	1625	477.94	2.78	1.22
Hoffman Run	2.17	930	428.57	2.07	1.05
King Run	2.20	1015	461.36	2.07	1.06
Ash Spring Run	2.07	935	451.69	1.97	1.05
Big Run	2.17	930	428.57	1.82	1.19
Pokejoy Run	1.68	600	357.14	1.63	1.03
Linton Creek	2.10	590	280.95	1.87	1.12
Thunder Hill Run	3.35	950	283.58	2.52	1.33
Powder House Run	2.27	1500	660.79	2.12	1.07
Slaughterhouse Run	1.28	1220	953.12	1.16	1.10
Montgomery Run	2.10	1130	538.10	1.85	1.14
Piney Swamp Run	5.47	1560	285.19	4.04	1.35
Lynnwood Run	1.38	785	568.84	1.23	1.12
Howell Run	3.28	1100	335.37	2.92	1.12
Deep Run	5.67	1420	250.44	4.93	1.15
Cranberry Run	2.29	820	358.08	2.12	1.08
Abram Creek	18.79	1565	83.29	12.58	1.49
Emory Run	3.40	700	205.88	3.01	1.13

Table of Stream Data.—(Continued).

Streams.	Total Distance. Miles	Total Fall. Feet.	Rate of Fall per Mile. Feet.	Air Line Distance. Miles.	Ratio T. D. to A. L. D.
Johnnycake Run	3.58	515	143.85	2.43	1.47
Wyckoff Run	1.58	385	243.67	1.25	1.26
Glade Run	2.64	400	151.52	1.45	1.82
Little Creek	1.75	300	171.43	1.66	1.05
Stony River	25.25	1655	65.54	16.97	1.49
Mill Run	3.27	220	67.28	2.56	1.28
Laurel Run	2.76	285	103.26	2.07	1.33
Helmick Run	3.65	200	54.79	3.50	1.04
Red Sea Run	1.35	480	355.55	1.23	1.10
Wymer Run	2.17	390	179.72	1.97	1.10
Difficult Creek	4.36	700	160.55	3.41	1.28
Buffalo Creek	5.18	900	173.75	4.50	1.15
Little Buffalo Creek	3.21	800	249.22	2.42	1.33
Red Oak Creek	3.63	700	192.84	3.11	1.17
Elk Run	2.79	530	189.96	2.25	1.24
South Branch Potomac River, source to mouth	131.15	3065	23.37	94.40	1.39
South Branch Potomac River, source to Hardy County Line	63.15	2710	42.91	49.60	1.27
South Branch Potomac River, Hardy County Line to mouth	68.00	355	5.23	45.60	1.49
Mill Creek, (Junction, North and South Mill Creeks to mouth)	2.64	40	15.15	2.45	1.08
Johnson Run, source to 1000-Foot Contour	1.85	1175	635.14	1.78	1.04
Johnson Run, 1000-Foot Contour to mouth	4.24	85	20.05	3.60	1.18
Sawmill Branch	3.08	930	301.95	2.96	1.04
North Mill Creek	16.13	1160	71.92	12.23	1.32
(Brushy Run)	5.52	900	163.04	4.57	1.21
(Stony Creek)	2.91	330	113.40	2.50	1.16
South Mill Creek	14.01	600	42.83	11.48	1.22
Elkhorn Run	5.95	1325	222.69	4.39	1.36
Spring Run	0.91	220	241.76	0.88	1.03
Long Run	2.53	590	233.20	2.27	1.11
Rough Run	3.48	1280	367.82	2.96	1.18
Waterfall Run	2.15	775	360.47	1.78	1.21
Wolfpen Hollow	4.20	1500	357.14	3.79	1.11
(Kessner Run)	3.14	890	274.69	2.92	1.11
Durgon Creek	5.23	570	108.99	3.85	1.36
Mitchell Run	4.64	900	193.97	4.19	1.11
Lunice Creek	19.78	1600	80.89	12.30	1.61
Robinson Run	6.95	930	133.81	5.06	1.37

Table of Stream Data.—(Concluded).

Streams.	Total Distance. Miles	Total Fall. Feet.	Rate of Fall per Mile. Feet.	Air Line Distance. Miles	Ratio T. D. to A. L. D.
Norman Run	5.25	325	61.90	4.40	1.19
Brushy Run	4.39	250	56.95	4.08	1.08
South Fork	11.20	2000	178.57	8.98	1.25
Bodkins Run	2.37	350	147.68	2.25	1.05
Shell Run	1.78	350	196.63	1.73	1.03
Saltblock Run	2.29	820	358.08	2.19	1.05
Hoglan Run	3.65	310	84.93	2.96	1.23
North Fork, Junction, Laurel and Straight Forks to Pendleton-Grant County Line	31.76	1280	40.30	27.62	1.15
North Fork, Pendleton-Grant County Line to mouth	10.46	280	26.77	7.10	1.47
Jordan Run	6.31	800	126.78	5.92	1.07
Big Run	2.47	1550	627.53	2.30	1.07
Laurel Run	3.01	1450	481.73	2.76	1.09
Broad Run	1.58	870	550.63	1.55	1.02
Samuel Run	2.56	1250	488.28	1.99	1.29
Broad Run	2.15	1400	651.16	2.05	1.05
Moyer Run	2.76	1760	637.68	2.47	1.12
High Ridge Run	2.37	1425	601.27	2.25	1.05
Mill Run	2.21	1440	651.58	1.97	1.12
Redman Run	2.99	1005	336.12	2.49	1.20
Long Run	3.09	925	299.35	2.74	1.13

AREAS OF DRAINAGE BASINS.

The following table, prepared by R. C. Tucker, gives a planimetric determination of the areas of the principal drainage basins of Mineral and Grant Counties, the joint topographic sheets of the United States and West Virginia Geological Surveys being used for authority:

Areas of Drainage Basins.

STREAMS	Sq. Miles
North Branch Potomac River, above Hampshire County Line	1340.72
Dan Run (Broad Hollow)	4.60
Patterson Creek (entire)	283.20
Rocky Run	8.35
Turners Run	4.70

Areas of Drainage Basins.—(Continued).

Streams.	Sq. Mi.
Painter Run (entire)	7.65
Long Pasture Run (entire)	2.40
Graveyard Run	0.55
Mill Run	1.65
Kellar Run	1.81
Horseshoe Run	2.29
Rinehart Run	1.78
Sugarcamp Run	1.15
Hazel Run	2.16
Cabin Run (entire)	23.18
Purgit Run (entire)	4.61
Ochre Run	0.82
Hollenbeck Run	3.44
Dowden Run	1.45
Sycamore Run	1.40
Beaver Run (entire)	8.21
Spring Run	0.64
Staggs Run (entire)	6.70
Mikes Run	1.32
Johnson Run	1.20
Mud Run	1.02
Mill Creek (entire)	18.32
Sugar Run	0.85
Parrill Run	0.82
Liller Run	2.81
Wild Meadow Run	3.00
Mud Run	0.65
Elliber Run	3.36
Mikes Run (entire)	19.42
Dry Run	0.83
Hilkey Run	4.56
Whip Run	5.51
Cave Run	0.69
Pursley Run	2.05
Clints Run	0.54
Buskirk Run	1.17
Harness Run	1.70
Rosser Run	6.93
Thorn Run (mouth below Williamsport)	9.10
North Fork (entire)	29.90
Elklick Run	9.74
Middle Fork	9.02
Thorn Run (mouth at Forman)	3.05
Ashcabin Run	2.83
Limestone Run	5.15
New Creek (entire)	53.00
Stony Run	1.92
Parr Spring Run	1.26
Block Run	2.55
Hoffman Run	1.30
King Run	1.89
Ash Spring Run	2.48
Big Run	1.80
Pokejoy Run	1.47

Areas of Drainage Basins.—(Continued).

Streams.	Sq. Mi.
Linton Creek	5.08
Thunder Hill Run	2.02
Powder House Run	1.99
Slaughterhouse Run	0.88
Montgomery Run	2.13
Piney Swamp Run	5.03
Lynnwood Run	2.03
Howell Run	6.94
Deep Run (entire)	9.97
Cranberry Run	2.46
Abram Creek (entire)	44.50
Emory Run	5.91
Johnnycake Run (entire)	4.70
Wyckoff Run	1.19
Glade Run	4.50
Little Creek	1.35
Stony River (entire)	59.29
Mill Run	5.40
Laurel Run	2.46
Helmick Run	4.68
Red Sea Run	1.58
Wymer Run	1.38
Difficult Creek	7.58
Buffalo Creek (entire)	10.08
Little Buffalo Creek	3.87
Red Oak Creek	3.12
Elk Run	3.80
South Branch Potomac River	1492.66
Mill Creek (entire)	103.66
Johnson Run (entire)	7.67
Sawmill Branch	1.71
North Mill Creek (entire)	47.42
(Brushy Run) (Pendleton County)	7.22
(Stony Creek) (Pendleton County)	4.33
South Mill Creek (entire)	46.71
Elkhorn Run	5.08
Spring Run	1.66
Long Run	2.60
Rough Run	2.10
Waterfall Run	1.48
Wolfpen Run	6.69
(Kessner Run) (Pendleton County)	3.24
Durgon Creek (entire)	8.53
Mitchell Run	4.21
Lunice Creek (entire)	88.67
Robinson Run	8.02
Norman Run	6.14
Brushy Run	10.28
South Fork (entire)	23.93
Bodkins Run	2.34
Shell Run	1.43
Saltblock Run	1.91
Hoglan Run	4.30
North Fork (entire)	326.06

Areas of Drainage Basins.—(Concluded).

Streams.	Sq. Mi.
Jordan Run (entire)	20.62
Big Run	3.38
Laurel Run	4.23
Broad Run	2.19
Samuel Run	3.17
Broad Run	2.12
Moyer Run	2.88
High Ridge Run	2.60
Mill Run	1.62
Redman Run	3.50
Long Run	3.11
Shaver Run (south corner of Grant County)	0.50

DESCRIPTIONS OF DRAINAGE BASINS.

Potomac River.

The Potomac River, affording an outlet to the entire drainage of both Mineral and Grant Counties, is formed by the junction of North and South Branches at a point 13 miles southeast of Cumberland and 3¾ miles eastward from the northeastern corner of Mineral County. The course of this river being entirely outside the boundaries of the two counties no detailed description is pertinent.

North Branch of Potomac River.

North Branch of Potomac River, which, with its tributaries, drains the entire area of Mineral County and that portion of Grant lying west of the Allegheny Front, as well as portions of Garrett and Allegany Counties, Maryland, rises at the Fairfax Stone at the point where Tucker, Preston, and Grant Counties corner with Garrett County, Maryland, at an elevation of 3,180 feet. Its course from this point is generally northeastward along a basin between Backbone Mountain and the Allegheny Front to Piedmont, a distance of 45.48 miles by the meanderings of the stream, its elevation at Piedmont being 900 feet, making a total fall of 2,280 feet, or at the rate of 50.13 feet per mile. At Piedmont it veers sharply southeastward, cutting a great gorge between the Allegheny Front and Dans Mountain, which are portions of one original range. At Keyser, (mouth of New Creek) 5.6 miles below Piedmont, it turns northeastward again and preserves this general course to Cumberland, a distance of 24.3 miles, its elevation at that point being 610 feet, making the rate of fall from Piedmont to Cumberland 9.70 feet per mile. At

Cumberland, where the river cuts through a low gap between Knobly Mountain and Shriver Ridge, it turns again southeastward and so continues to its junction with South Branch near French Station (South Branch P. O.), the length of this section being 20.8 miles with a total fall of 70 feet, or at the rate of 3.37 feet per mile, the elevation at the junction being 540 feet. The entire length of the river from head to mouth is 96.18 miles, and the area of its drainage basin 1,384.29 square miles.

Ancient, entrenched meanders are conspicuous between the mouth of Stony River and Piedmont, and again between Keyser and French, but they are noticeably absent in the five-mile section between Piedmont and Keyser, indicating that the current must have remained swift in this portion during the period of peneplanation. Its present cycle is one of comparative youth, there being high valley walls and a moderately swift current with few recent meanders.

Its principal tributaries, in ascending order, are Greenspring Creek, Dan Run, Patterson, Evitts, Wills, New, and Georges Creeks, Savage River, Abram Creek, Stony River, Difficult Creek, Glade Run, and Buffalo and Red Oak Creeks.

A gaging station was established at Piedmont by the United States Geological Survey on June 27, 1899, and careful records of the North Branch were kept until July 15, 1906, when the station was discontinued. The description of this station, as detailed in Water-Supply Paper No. 167, page 53, is as follows:

North Branch of Potomac River at Piedmont, W. Va.

"This station was established June 27, 1899, by E. G. Paul. It is located at the iron highway bridge connecting Luke, Md., with Piedmont, W. Va.

"The channel is straight for 1,200 feet above and 600 feet below the station. The current has a moderate velocity. The right bank is high and rocky and will not overflow. The left bank is low and liable to overflow, but all water passes beneath the bridge. The bed of the stream is composed of gravel and cobblestones, is free from vegetation, and is permanent.

"Discharge measurements are made from the bridge to which the gage is attached from the downstream side. The initial point for soundings is the face of the pier on the right bank.

"The standard chain gage is attached to the hand rail on the lower side of the bridge in the span next to the right bank. The length of the chain from the end of the weight to the marker is 38.87 feet. The gage is read twice each day by Charles H. Beck. The bench mark is the top of a small shoulder in the face of the sandstone ledge which forms the right abutment of the bridge. It is about 4 feet above the ground and 10 feet downstream from the bridge. The point is indicated by an arrow cut in the vertical face of the ledge. Its elevation is 20.40 feet above gage datum."

The data gathered at the above station are published in full below, that for the years 1899 and 1900 being taken from the Report of the Maryland Geological Survey on Garrett County, Maryland, pages 282-283, as therein assembled from various reports of the United States Geological Survey. The records for the years 1901 to 1906, both inclusive, are taken directly from United States Water-Supply Papers, as follows:

1901, From No. 65, pages 229 and 318.
1902, From No. 82, pages 168 and 169.
1903, From No. 97, pages 323 and 324.
1904, From No. 126, page 62.
1905, From No. 167, pages 53, 54, and 55.
1906, From No. 203, pages 48 and 49.

Daily Gage Height of North Branch of Potomac River at Piedmont, W. Va., for 1899.

Day	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	3.15	2.50	2.20	2.20	3.75	2.60
2	.....	2.90	2.35	2.20	2.20	3.90	2.60
3	.....	2.80	2.25	2.10	2.15	3.05	2.60
4	.....	2.70	2.40	2.00	2.10	2.80	2.55
5	.....	2.65	2.40	2.30	2.10	2.70	2.50
6	.....	2.70	2.40	2.20	2.10	2.55	2.40
7	.....	2.80	2.55	2.15	2.20	2.50	2.40
8	.....	2.70	2.30	2.10	2.10	2.40	2.40
9	.....	2.70	2.30	2.20	2.15	2.40	2.35
10	.....	2.70	2.25	2.30	2.10	2.40	2.40
11	.....	2.65	2.10	2.95	2.10	2.40	2.50
12	.....	2.50	2.15	3.40	2.20	2.40	5.20
13	.....	2.40	2.10	2.75	2.10	2.30	4.60
14	.....	2.85	2.10	2.45	2.10	2.30	3.75
15	.....	2.85	2.10	2.35	2.00	2.30	3.60
16	.....	2.50	2.00	2.30	2.20	2.30	3.35
17	.....	2.70	2.00	2.30	2.10	2.30	3.05
18	.....	2.90	2.00	2.15	2.10	2.20	3.15
19	.....	2.65	2.00	2.10	2.10	2.40	3.20
20	.....	2.50	2.00	2.45	2.10	3.35	3.70
21	.....	2.35	2.00	2.90	2.10	3.00	3.30
22	.....	.....	1.95	2.65	2.00	2.80	3.20
23	.....	2.30	1.90	2.40	2.00	2.85	3.10
24	.....	2.30	1.90	2.40	2.10	3.30	3.00
25	.....	2.30	1.90	2.25	2.10	3.20	3.00
26	.....	2.20	1.90	2.20	2.10	3.00	2.90
27	3.00	2.15	2.10	2.30	2.10	2.80	2.80
28	2.90	2.50	3.00	2.55	2.10	2.80	2.80
29	3.85	2.35	2.90	2.40	2.20	2.70	2.80
30	3.50	2.30	2.55	2.25	2.15	2.60	2.80
31	.....	2.45	2.35	.....	2.15	.....	2.70

Daily Gage Height of North Branch of Potomac River at Piedmont, W. Va., for 1900.

Day	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.70	3.00	3.55	4.60	3.15	3.30	3.00	2.95	2.10	2.85	2.10	3.55
2	2.70	3.05	4.50	4.80	3.10	3.25	2.85	2.75	2.00	2.45	2.10	3.45
3	2.70	3.10	4.10	4.65	3.10	3.25	2.70	2.65	2.00	2.20	2.25	3.25
4	2.70	3.10	4.00	4.50	3.10	3.05	2.70	2.60	2.00	2.10	2.65	5.80
5	2.70	3.35	4.30	4.25	3.00	2.90	2.70	2.40	2.00	2.20	2.70	5.65
6	2.80	3.60	4.25	4.15	2.95	2.85	2.60	2.30	1.95	2.20	2.50	4.70
7	2.90	3.70	5.80	4.15	2.90	2.85	2.70	2.30	1.90	2.20	2.40	4.25
8	3.00	5.30	5.00	4.30	2.90	3.15	3.00	2.20	1.90	2.10	2.30	4.00
9	3.30	5.40	4.55	4.20	2.95	3.15	2.85	2.20	1.90	2.05	2.40	3.80
10	3.50	4.65	4.40	3.95	3.20	2.95	2.70	2.10	1.90	2.00	2.50	3.60
11	3.50	4.40	4.30	3.75	3.05	2.80	2.60	2.05	1.80	2.00	2.50	3.40
12	4.70	4.05	4.15	3.70	3.00	2.70	2.45	2.00	1.80	2.00	2.60	3.40
13	4.25	5.90	4.10	3.65	2.90	2.70	2.60	2.10	1.80	2.00	2.60	3.40
14	3.90	5.50	4.10	3.55	2.80	3.15	2.65	2.00	1.80	3.05	2.50	3.30
15	3.90	4.80	4.00	3.40	2.80	3.20	2.55	2.00	1.80	3.20	2.50	3.30
16	3.90	4.35	3.80	3.40	2.80	3.95	2.35	2.10	1.80	2.65	2.40	3.20
17	4.40	4.15	3.70	3.40	2.80	7.55	2.30	2.40	1.90	2.45	2.40	3.05
18	4.10	4.05	3.70	3.55	2.70	5.85	2.25	2.25	1.90	2.40	2.40	3.15
19	4.15	3.70	4.00	3.75	3.40	4.95	2.35	2.25	1.90	2.25	2.40	3.20
20	5.80	3.65	5.95	3.65	3.95	4.45	2.90	2.45	1.90	2.20	2.50	3.25
21	5.70	3.60	5.35	3.50	3.55	3.95	2.75	2.20	1.80	2.10	2.60	3.25
22	4.75	3.75	4.75	3.50	3.35	3.65	2.55	2.20	1.80	2.10	3.20	3.05
23	4.35	4.00	4.60	3.65	3.20	3.50	2.45	2.65	1.80	2.15	3.00	3.00
24	4.10	3.70	4.60	3.85	3.15	3.35	2.40	2.45	1.80	2.35	2.90	3.05
25	3.95	3.60	4.50	3.65	3.05	3.25	3.20	2.40	1.80	2.80	3.35	3.05
26	3.80	3.40	4.25	3.50	3.00	3.25	4.05	2.45	1.80	2.50	7.95	3.05
27	3.55	3.40	4.35	3.40	2.95	3.05	4.40	2.45	1.85	2.35	5.20	2.90
28	3.40	3.40	4.15	3.40	2.90	2.90	3.20	2.30	1.90	2.30	4.45	2.90
29	3.30	.....	4.00	3.30	3.30	3.55	3.00	2.20	1.95	2.20	4.05	3.45
30	3.20	.....	4.75	3.25	3.25	3.15	3.00	2.15	2.70	2.20	3.75	3.05
31	3.10	.....	4.60	.....	3.10	.....	3.25	2.10	.....	2.20	.....	3.30

List of Discharge Measurements Made on North Branch of Potomac River at Piedmont, West Virginia.

Date	Hydrographer	Gage Height Feet.	Discharge. Sec.-Ft.
June 27, 1899	E. G. Paul	3.00	350
February 22, 1900	E. G. Paul	3.75	735
June 20, 1900	E. G. Paul	4.40	1,249
September 12, 1900	C. R. Olberg	1.80	34

Estimated Monthly Discharge of North Branch of Potomac River at Piedmont, W. Va.

(Drainage area, 407 square miles.)

Month	Discharge in Second-Feet.			Total in acre-feet	Run-Off	
	Max.	Min.	Mean		Second-feet per square mile	Depth in Inches
1899.						
June 27 to 30			515			
July	410	112	228	14,019	0.56	0.65
August	352	55	132	8,116	0.32	0.37
September	525	77	174	10,354	0.43	0.48
October	124	77	104	6,395	0.26	0.30
November	845	124	287	17,078	0.71	0.79
December	1 880	162	419	25,763	1.03	1.19
The year						
1900.						
January	2,360	259	799	49,129	1.96	2.26
February	2,440	352	961	53,371	2.36	2.45
March	2,480	705	1,237	76,060	3.04	3.50
April	1,560	452	808	48,079	1.99	2.22
May	883	259	393	24,165	0.96	1.11
June	3,760	259	691	41,117	1.70	1.90
July	1,240	136	321	19,737	0.79	0.91
August	336	77	154	9,469	0.38	0.44
September	259	34	58	3,451	0.14	0.16
October	430	77	158	9,715	0.39	0.45
November	4,080	100	483	28,740	1.19	1.33
December	2,360	320	648	39,844	1.59	1.83
The year	4,080	34	559	402,877	1.37	18.56

Daily Gage Height, in Feet, of North Branch of Potomac River at Piedmont, W. Va., for 1901.

Day	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
1	3.40	3.30	2.85	3.80	4.00	4.25	3.35	2.50	3.20	2.55	2.10	2.50
2	3.20	3.20	3.00	3.65	3.90	4.40	3.15	2.50	3.00	2.40	2.10	2.70
3	2.95	3.20	4.00	4.00	3.80	4.10	3.00	2.40	2.90	2.40	2.10	5.65
4	2.95	3.20	5.20	4.00	3.75	3.90	3.00	2.40	2.80	2.50	2.10	5.20
5	3.15	3.30	4.60	4.45	3.60	3.70	2.90	2.30	2.70	2.40	2.10	4.20
6	3.10	3.30	3.85	6.55	3.40	3.60	2.80	2.40	2.60	2.40	2.10	3.50
7	3.00	3.20	3.80	6.30	3.40	4.00	2.80	3.35	2.55	2.35	2.10	3.50
8	2.90	3.20	3.80	5.65	3.30	4.00	2.80	2.85	2.50	2.25	2.10	3.50
9	3.00	3.10	4.70	5.00	5.75	3.80	2.70	2.60	2.50	2.20	2.00	3.55
10	3.00	3.10	6.20	4.65	7.55	3.55	2.60	2.50	2.40	2.20	2.00	5.70
11	4.00	3.20	6.90	4.50	5.90	3.35	2.45	2.45	2.60	2.20	2.00	4.55
12	5.75	3.10	5.65	4.30	5.25	3.15	2.40	2.35	2.70	2.20	2.05	4.05
13	4.65	3.00	5.15	4.20	4.90	4.25	2.60	2.30	2.65	2.25	2.10	3.80
14	4.15	3.00	5.20	4.65	4.60	3.95	3.50	2.45	2.60	2.30	2.20	4.30
15	4.10	2.90	4.75	5.25	4.25	4.30	3.80	2.30	2.50	2.30	2.30	8.15
16	4.00	3.00	4.40	5.60	4.10	4.90	5.30	2.30	2.45	2.25	2.20	5.55
17	3.90	3.10	4.10	5.70	3.95	4.95	5.10	2.45	2.55	2.20	2.10	4.65
18	3.55	3.15	4.05	5.40	3.80	4.70	4.25	3.15	2.60	2.20	2.10	4.20
19	3.25	3.60	4.05	4.95	3.70	4.30	4.15	3.10	2.60	2.10	2.10	3.80
20	3.35	3.40	4.15	7.60	3.75	4.05	3.55	3.35	2.50	2.10	2.10	3.40
21	3.50	3.20	4.55	7.55	3.70	3.75	3.20	3.60	2.40	2.10	2.10	3.40
22	3.90	3.10	4.35	6.35	4.55	3.55	3.10	3.35	2.40	2.10	2.10	3.40
23	3.70	3.00	4.20	5.85	5.60	3.45	2.95	3.35	2.30	2.10	2.15	3.55

Daily Gage Height, in Feet, of North Branch of Potomac River at Piedmont, W. Va., for 1901.—(Continued).

Day	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
24	3.60	2.85	4.05	5.65	4.65	3.20	2.90	4.95	2.30	2.10	2.70	3.50
25	4.00	2.95	4.15	5.35	4.30	3.10	2.80	4.80	2.30	2.10	3.00	4.70
26	3.70	2.95	4.15	5.05	4.55	3.20	2.70	3.90	2.20	2.10	2.85	4.30
27	3.70	2.90	4.55	4.65	6.25	3.95	2.70	3.55	2.20	2.10	2.65	4.95
28	3.55	2.85	4.25	4.35	6.15	4.80	2.70	3.65	2.25	2.10	2.55	4.25
29	3.35	.....	4.05	4.20	5.90	4.40	2.60	3.45	2.90	2.10	2.45	6.65
30	3.50	.....	3.90	4.10	5.55	3.70	2.50	3.15	2.90	2.10	2.60	5.80
31	3.35	.....	3.75	.....	5.05	.....	2.50	3.00	.....	2.10	.....	4.80

During 1901 the following measurements were made by Mr. E. G. Paul:

July 24: Gage height, 2.90 feet; discharge, 275 second-feet.

November 7: Gage height, 2.10 feet; discharge, 39 second-feet.

Rating Table, North Branch of Potomac River at Piedmont, W. Va., for 1901-1902.

Gage Height Feet	Discharge Sec.-Ft.	Gage Height Feet	Discharge Sec.-Ft.	Discharge Sec.-Ft.	Gage Height Feet
1.8	34	4.0	920	6.2	2,680
2.0	77	4.2	1,080	6.4	2,840
2.2	124	4.4	1,240	6.6	3,000
2.4	175	4.6	1,400	6.8	3,160
2.6	230	4.8	1,560	7.0	3,320
2.8	289	5.0	1,720	7.2	3,480
3.0	352	5.2	1,880	7.4	3,640
3.2	430	5.4	2,040	7.6	3,800
3.4	525	5.6	2,200	7.8	3,960
3.6	640	5.8	2,360	8.0	4,120
3.8	775	6.0	2,520	8.5	4,520
				9.0	4,920

The following discharge measurement was made during 1902, by E. G. Paul:

August 19: Gage height, 2.14 feet; discharge, 50 second-feet.

Daily Gage Height, in Feet, of North Branch of Potomac River at Piedmont, W. Va., for 1902.

(Charles H. Beck, Observer.)

Day	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
1	4.45	3.80	8.05	4.90	3.55	3.30	4.75	2.85	1.90	3.30	2.60	4.00
2	4.00	3.60	7.10	4.65	3.40	3.20	3.80	2.70	1.90	3.35	2.50	3.75
3	4.30	3.50	6.20	4.40	3.70	3.10	3.35	2.60	1.90	2.85	2.50	5.25
4	3.80	3.20	5.40	4.70	3.70	3.00	3.20	2.50	2.00	2.70	2.40	4.55
5	3.55	3.40	4.95	5.05	3.55	3.00	3.10	2.50	2.20	2.90	2.40	4.30
6	3.60	3.50	4.50	5.95	3.45	2.85	2.95	2.50	2.35	2.90	2.40	3.90

Daily Gage Height, in Feet, of North Branch of Potomac River at Piedmont, W. Va., for 1902.—(Continued).

Day	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
7	3.60	3.50	4.20	6.20	3.50	2.80	2.80	2.50	2.20	2.85	2.40	3.80
8	3.60	3.40	4.20	6.45	3.40	2.85	3.05	2.40	2.10	2.60	2.50	3.75
9	3.45	3.30	4.65	5.85	3.30	2.95	3.20	2.40	2.00	2.50	2.50	3.50
10	3.45	3.20	4.95	5.70	3.20	2.85	2.95	2.45	2.00	2.40	2.50	3.45
11	3.40	3.15	5.65	6.20	3.40	2.70	3.20	2.50	2.00	2.40	2.50	5.65
12	3.30	3.15	6.85	7.05	3.25	2.70	3.05	2.40	2.00	3.25	2.50	6.45
13	3.10	3.10	8.10	6.25	3.20	2.60	2.80	2.35	1.90	3.70	2.50	6.00
14	3.20	3.05	6.60	5.80	3.15	3.10	2.70	2.30	1.90	3.35	2.50	5.80
15	3.20	3.10	5.85	5.55	3.10	2.90	2.60	2.25	1.90	3.15	2.40	5.00
16	3.10	3.00	5.85	5.25	3.10	2.80	2.50	2.20	1.90	2.95	2.40	7.60
17	3.05	3.00	6.75	5.10	3.00	2.70	2.45	2.20	1.90	2.70	2.45	6.45
18	2.90	3.00	5.65	4.95	3.00	2.60	2.40	2.20	1.90	2.70	2.50	5.45
19	3.00	3.00	4.95	4.55	2.90	2.50	2.40	2.15	1.90	2.70	2.50	4.90
20	2.90	2.85	4.60	4.40	3.45	2.50	2.55	2.10	1.90	2.60	2.50	4.70
21	2.90	2.80	4.45	4.25	3.75	2.60	2.60	2.15	1.90	2.50	2.50	5.00
22	2.90	2.80	4.50	4.15	3.45	2.90	2.50	2.50	2.00	2.40	2.50	5.90
23	2.90	3.00	4.50	4.25	3.40	2.70	2.40	2.40	2.00	2.40	2.50	5.15
24	3.00	3.05	4.50	4.15	3.30	2.50	2.40	2.30	2.00	2.40	2.50	4.70
25	3.00	3.35	4.45	3.80	3.30	2.40	2.30	2.20	2.00	2.40	2.75	4.50
26	3.30	6.55	4.25	3.70	3.60	2.80	2.30	2.10	2.20	2.40	5.45	4.10
27	5.75	6.05	4.15	3.65	4.10	3.00	2.30	2.10	2.20	2.40	4.50	3.80
28	5.00	10.50	4.20	3.55	4.00	2.70	2.30	2.00	2.65	(a)	3.85	3.70
29	4.65	.....	5.50	3.60	3.80	2.60	2.30	1.90	2.40	(a)	3.60	3.55
30	4.10	.....	5.30	3.70	3.60	2.75	2.20	1.90	2.45	2.80	3.50	4.00
31	4.05	.....	5.25	.....	3.35	.....	2.30	1.90	.....	2.70	.....	3.70

(a) Gage chain broken.

Estimated Monthly Discharge of North Branch of Potomac River at Piedmont, W. Va., for 1902.

(Drainage area, 409 square miles.)

MONTH	Discharge in Sec.-Ft.			Run-off	
	Maximum	Minimum	Mean	Second-feet per square mile	Depth in inches.
January	2,304	320	688	1.68	1.94
February	6,120	289	809	1.98	2.06
March	4,160	1,040	2,008	4.91	5.66
April	3,360	610	1,666	4.07	4.54
May	1,000	320	553	1.35	1.56
June	475	175	292	.71	.79
July	1,520	124	313	.77	.89
August	305	55	153	.37	.43
September	245	55	91	.22	.25
October	705	175	288	.70	.81
November	2,080	175	347	.85	.95
December	3,800	552	1,516	3.71	4.28
The year	6,120	55	727	1.78	24.16

The following discharge measurement was made by E. G. Paul in 1903:

August 31: Gage height, 2.80 feet; discharge, 208 second-feet.

Mean Daily Gage Height, in Feet, of North Branch of Potomac River at Piedmont, W. Va., for 1903.

(Charles H. Beck, Observer.)

Day	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
1	3.45	5.20	6.70	4.85	3.60	3.75	4.45	2.90	2.80	2.05	2.30	2.40
2	3.60	6.05	5.55	4.75	3.50	3.55	4.50	2.85	2.65	2.10	2.30	2.45
3	6.80	6.40	5.00	4.45	3.55	3.40	3.75	2.90	2.50	2.10	2.20	2.25
4	6.15	8.20	4.65	4.95	4.55	3.30	3.70	3.00	2.40	2.20	2.20	2.25
5	5.25	6.15	4.50	4.45	3.75	3.20	4.15	3.00	2.30	2.20	2.25	2.30
6	4.80	5.25	4.50	4.20	3.60	3.25	5.20	2.80	2.50	2.45	2.40	2.30
7	4.50	4.75	4.60	4.20	3.60	5.25	4.05	2.80	2.50	(a)	2.70	2.30
8	4.20	4.60	5.20	5.15	3.50	4.55	3.65	2.70	2.35	(a)	2.50	2.20
9	3.80	4.35	6.10	5.95	3.45	4.10	3.45	2.65	2.30	(a)	2.35	2.30
10	3.80	4.00	5.40	5.20	3.40	3.90	3.30	2.50	2.70	(a)	2.30	2.30
11	3.80	4.15	4.95	4.70	3.35	4.50	3.25	2.50	2.45	(a)	2.30	2.30
12	4.35	5.05	4.80	4.60	3.20	4.35	3.30	2.50	2.40	(a)	2.30	2.20
13	3.95	4.65	4.50	4.45	3.20	4.80	4.00	2.45	2.30	(a)	2.30	2.15
14	3.75	4.50	4.30	5.30	3.10	4.80	4.10	2.40	2.20	(a)	2.30	2.20
15	3.70	4.80	4.15	5.60	3.10	5.10	3.75	2.40	2.15	(a)	2.30	2.20
16	3.70	6.95	4.00	6.05	3.10	4.55	3.50	2.40	2.10	2.50	2.30	2.30
17	3.70	5.70	3.90	5.45	3.10	4.30	3.30	2.40	2.35	2.50	2.85	2.40
18	3.50	4.95	3.80	5.00	3.00	4.00	3.45	2.60	2.70	2.60	3.65	2.20
19	3.75	4.50	3.70	4.70	3.00	3.60	3.40	2.50	2.65	2.70	3.10	2.20
20	3.60	4.35	3.60	4.40	2.90	3.65	3.40	2.95	2.50	2.65	2.70	2.30
21	3.45	4.15	3.75	4.20	2.90	4.50	3.50	2.80	2.30	2.60	2.70	2.70
22	3.50	4.00	4.55	4.00	2.80	4.15	3.35	2.60	2.20	2.50	2.70	3.20
23	3.45	3.85	6.65	3.90	3.25	6.10	3.15	2.50	2.20	2.40	2.60	2.70
24	3.20	3.90	6.00	3.80	3.90	5.15	3.00	2.40	2.15	2.40	2.60	2.85
25	3.20	3.80	5.15	3.80	4.70	4.45	2.95	2.30	2.10	2.40	2.60	4.45
26	3.25	3.70	4.70	4.30	4.60	4.00	2.90	2.40	2.10	2.30	2.50	3.80
27	3.25	4.05	4.40	4.20	4.15	3.85	2.80	2.40	2.05	2.30	2.40	3.25
28	4.75	8.80	4.25	3.85	4.00	4.10	2.70	2.65	2.10	2.30	2.30	3.20
29	5.85	.....	4.05	3.70	3.80	6.65	2.65	2.55	2.00	2.30	2.40	3.20
30	7.30	.....	4.00	3.70	3.70	5.20	2.70	2.70	2.00	2.30	2.40	2.95
31	5.70	.....	4.10	.....	3.80	.....	3.00	2.80	.....	2.30	.....	2.85

(a) No record from October 7 to 15, inclusive. Observer absent.

Rating Table for North Branch of Potomac River at Piedmont, W. Va., from January 1 to December 31, 1903.

Gage height Feet	Discharge Second-feet	Gage height Feet	Discharge Second-feet	Gage height Feet	Discharge Second-feet
1.9	8	2.8	210	3.7	634
2.0	23	2.9	242	3.8	701
2.1	39	3.0	277	3.9	776
2.2	57	3.1	316	4.0	860
2.3	77	3.2	359	4.1	945
2.4	100	3.3	406	4.2	1,030
2.5	125	3.4	457	4.3	1,115
2.6	152	3.5	512		
2.7	180	3.6	571		

"Tangent at 4.0 feet gage height. Differences above this point 85 per tenth. Table is approximate above 4.4 feet."

Estimated Monthly Discharge of North Branch of Potomac River at Piedmont, W. Va., for 1903.

(Drainage area, 406 square miles.)

MONTH	Discharge in second-feet			Run-off	
	Maximum.	Minimum	Mean	Second-feet per sq.mile.	Depth in inches.
January	3,665	359	1,097	2.70	3.11
February	4,940	634	1,736	4.28	4.46
March	3,155	571	1,453	3.58	4.13
April	2,602	634	1,368	3.37	3.76
May	1,455	210	572	1.41	1.63
June	3,112	359	1,170	2.88	3.21
July	1,880	166	560	1.38	1.59
August	277	77	163	.40	.46
September	210	23	90	.22	.25
October	180	31	103	.25	.29
November	602	57	134	.33	.37
December	1,242	48	191	.47	.54
The year	4,940	23	720	1.77	23.80

Discharge Measurements of North Branch of Potomac River at Piedmont, W. Va., in 1904.

Date	Hydrographer	Width Feet	Area of section Sq. Feet	Mean velocity Ft. per Sec.	Gage Height Feet	Discharge Sec.-Ft.
July 8	Hoyt and Hall	115	158	0.73	2.80	116
September 9	E. C. Murphy	50	21	.62	1.99	13
September 28	E. C. Murphy	47	27	.74	1.99	20

Mean Daily Gage Height, in Feet, of North Branch of Potomac River at Piedmont, W. Va., for 1904.

(Charles H. Beck, Observer.)

Day	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.90	3.20	4.70	4.70	4.45	3.95	3.00	2.35	1.90	2.00	2.00	2.10
2	2.95	3.05	4.55	5.25	4.20	3.85	3.10	2.55	1.90	2.00	2.00	2.05
3	3.00	3.10	4.85	4.75	3.95	3.80	3.05	2.40	2.00	2.05	2.05	2.20
4	3.55	3.05	5.55	4.35	3.85	3.70	2.85	2.40	1.85	2.00	2.10	2.30
5	3.10	3.05	4.40	4.15	3.75	3.80	2.70	2.40	2.00	1.95	2.10	2.20
6	2.95	3.10	4.20	4.00	3.65	3.90	2.65	2.35	2.10	1.95	2.00	2.20
7	3.15	6.20	4.65	3.90	3.60	3.75	2.70	2.25	1.90	2.00	2.10	2.25
8	3.00	6.10	5.55	3.90	3.50	3.60	2.80	2.20	1.90	2.15	2.10	2.20
9	2.90	4.70	4.70	4.30	3.50	3.50	2.80	2.05	1.95	2.10	2.10	2.05
10	2.80	4.05	4.30	4.15	3.60	3.60	3.45	2.15	2.10	2.10	2.10	2.00
11	2.80	3.80	4.25	3.95	3.45	3.50	3.20	2.20	2.00	2.15	2.20	2.10
12	2.80	3.60	4.30	3.85	3.35	3.40	3.05	2.20	2.00	2.20	2.20	2.10
13	2.70	3.25	4.05	3.85	3.20	3.25	2.90	2.20	2.00	2.40	2.20	2.20

Mean Daily Gage Height, in Feet, of North Branch of Potomac River at Piedmont, W. Va., for 1904.—(Continued).

Day	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
14	2.70	3.35	3.95	3.70	3.20	3.20	2.80	2.20	2.00	2.25	2.20	2.30
15	2.60	3.45	3.85	3.70	3.40	3.20	2.70	2.15	2.05	2.20	2.20	2.30
16	2.60	3.25	3.65	3.75	3.40	3.00	2.60	2.15	2.10	2.15	2.20	2.30
17	2.60	3.05	3.55	3.90	3.20	3.10	2.50	2.20	2.10	2.10	2.20	2.30
18	3.15	3.00	3.85	3.80	3.70	3.00	2.45	2.10	2.10	2.05	2.20	2.30
19	3.00	3.10	3.95	3.70	5.95	2.90	2.35	2.10	2.10	2.10	2.30	2.30
20	2.95	3.00	4.40	3.60	5.00	3.00	2.35	2.15	2.00	2.10	2.30	2.30
21	3.80	3.20	4.50	3.50	5.00	3.05	2.50	2.20	2.10	2.20	2.30	2.30
22	a6.80	4.45	4.95	3.45	4.60	3.60	2.90	2.20	2.15	2.20	2.30	2.30
23	6.65	4.25	6.60	3.40	4.25	3.45	3.20	2.20	2.10	2.20	2.30	2.30
24	5.30	4.85	5.60	3.35	4.05	3.05	2.90	2.20	2.10	2.20	2.30	2.45
25	4.25	4.10	5.05	3.45	3.90	2.90	2.70	2.20	1.90	2.20	2.25	4.80
26	4.00	3.70	4.95	3.90	3.75	2.80	2.70	2.10	2.05	2.20	2.25	4.00
27	3.55	3.55	4.80	4.65	3.85	2.70	2.60	2.10	2.00	2.10	2.20	4.10
28	3.25	3.50	4.40	5.25	3.85	2.75	2.50	1.90	2.00	2.20	2.15	4.80
29	3.30	4.75	4.10	4.95	3.60	3.25	2.60	2.00	2.00	2.10	2.10	4.05
30	3.40	.....	4.00	4.55	3.50	3.05	2.50	2.00	2.00	2.00	2.10	3.20
31	3.25	.....	4.45	.....	3.50	.....	2.40	1.90	.....	2.10	.....	3.20

(a) Ice went out 1:05 p. m.

Discharge Measurements of North Branch of Potomac River at Piedmont, W. Va., in 1905.

Date	Hydrographer	Width Feet	Area of section Sq. feet	Mean velocity Feet per Sec.	Gage height Feet	Discharge Sec.-Ft.
March 9	E. C. Murphy	286	1,076	4.20	6.70	4,516
March 10	E. C. Murphy	286	1,305	4.63	7.47	6,047
March 29	E. C. Murphy	153	339	3.23	4.25	1,096
April 18	N. C. Grover	144	235	1.77	3.46	416
April 24	A. H. Horton	146	277	1.90	3.63	526
May 4	Tillinghast and Soper	143	227	1.43	3.22	326
June 7	R. H. Bolster	144	263	1.67	3.44	441
July 17	N. C. Grover	142	195	1.44	3.15	280
November 7	Hanna and Grieve	145	258	1.70	3.38	439

Mean Daily Gage Height, in Feet, of North Branch of Potomac River at Piedmont, W. Va., for 1905.

(Charles H. Beck, Observer.)

Day	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
1	3.05	2.75	3.35	3.85	3.5	4.75	3.3	3.85	2.8	2.3	3.2	3.9
2	3.05	2.7	3.25	3.7	3.3	4.0	3.85	3.45	2.8	2.3	3.1	3.75
3	3.05	2.65	3.15	3.6	3.3	3.65	3.55	3.2	2.8	2.4	3.05	5.75
4	2.95	2.55	3.15	3.55	3.2	3.4	3.4	3.1	2.8	2.45	3.0	4.9
5	2.95	2.55	3.35	3.55	3.2	3.3	4.05	3.5	2.7	2.4	3.0	4.4
6	2.95	2.55	4.15	3.8	3.2	3.2	4.2	3.15	2.6	2.35	3.15	3.95
7	2.9	2.55	4.5	3.95	3.3	3.55	4.3	3.0	2.5	2.3	3.35	3.85
8	2.8	2.55	5.0	3.95	3.2	4.15	5.45	2.85	2.5	2.2	3.2	3.7
9	2.75	2.55	7.05	3.95	3.1	3.65	4.55	2.8	2.5	2.2	3.2	3.65
10	2.65	3.15	7.45	4.0	3.1	3.45	4.05	2.8	2.45	2.2	3.05	3.6

Mean Daily Gage Height, in Feet, of North Branch of Potomac River at Piedmont, W. Va., for 1905.—(Continued).

Day	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
11	2.75	3.1	6.3	3.95	3.15	3.85	4.1	3.2	4.2	2.65	3.0	3.3
12	2.8	3.05	5.7	3.95	3.5	4.2	4.0	3.25	4.15	3.6	2.9	3.25
13	5.95	3.05	5.65	3.85	3.9	4.15	3.95	3.0	3.6	3.05	2.9	3.35
14	4.45	3.4	5.3	3.75	3.65	3.75	3.5	2.8	3.25	2.75	2.9	3.25
15	3.65	3.3	5.0	3.65	5.05	3.45	3.35	2.85	3.05	2.6	2.9	3.0
16	3.3	3.05	4.85	3.55	4.4	3.25	3.3	4.15	2.9	2.55	2.85	2.95
17	3.25	2.95	6.1	3.5	4.55	3.05	3.15	3.5	2.8	2.5	3.05	3.3
18	3.25	2.95	6.45	3.5	4.05	3.65	3.05	3.15	2.8	2.45	3.0	3.2
19	3.25	2.85	6.75	3.45	3.95	3.45	2.95	3.0	2.8	3.8	2.9	3.1
20	3.25	2.85	6.7	3.75	3.75	3.65	3.25	2.95	2.7	4.45	2.9	3.1
21	3.25	2.85	8.1	3.85	3.55	3.65	3.30	2.9	2.6	4.0	2.9	4.0
22	3.3	2.95	6.75	3.9	3.5	3.65	3.10	2.75	2.55	3.4	2.75	5.4
23	3.15	3.4	5.8	3.85	3.4	3.4	3.65	2.65	2.5	3.15	2.75	4.9
24	3.05	3.3	5.25	3.7	3.2	3.45	3.6	2.5	2.4	3.0	2.85	4.9
25	2.85	3.25	5.65	3.6	3.1	3.65	3.25	4.35	2.45	2.95	2.8	4.05
26	2.55	3.25	5.05	3.5	3.1	3.45	3.05	4.9	2.4	4.85	2.8	4.0
27	2.55	3.55	4.9	2.8	3.1	4.4	2.9	3.7	2.4	4.4	2.8	3.85
28	2.75	3.45	4.6	2.9	3.0	3.65	2.8	3.35	2.3	3.9	2.8	3.65
29	2.75	.....	4.3	2.65	2.9	3.35	2.9	3.15	2.3	3.6	3.65	3.8
30	2.85	.....	4.15	3.5	2.9	3.2	5.05	3.0	2.3	3.45	4.55	4.15
31	2.75	.....	4.0	.....	3.15	.....	4.2	3.0	.....	3.3	.....	3.65

"Note.—Ice went out March 7."

Station Rating Table for North Branch of Potomac River at Piedmont, W. Va., from January 1, 1904, to December 31, 1905.

Gage height Feet	Discharge Second-feet	Gage height Feet	Discharge Second-feet	Gage height Feet	Discharge Second-feet	Gage height Feet	Discharge Second-feet
2.00	15	3.60	515	5.10	2,010	6.60	4,340
2.10	24	3.70	584	5.20	2,130	6.70	4,530
2.20	36	3.80	660	5.30	2,260	6.80	4,720
2.30	51	3.90	742	5.40	2,390	6.90	4,910
2.40	68	4.00	830	5.50	2,530	7.00	5,100
2.50	88	4.10	923	5.60	2,670	7.10	5,300
2.60	110	4.20	1,020	5.70	2,820	7.20	5,500
2.70	134	4.30	1,120	5.80	2,970	7.30	5,700
2.80	161	4.40	1,225	5.90	3,130	7.40	5,910
2.90	191	4.50	1,330	6.00	3,290	7.50	6,120
3.00	224	4.60	1,440	6.10	3,460	7.60	6,330
3.10	261	4.70	1,550	6.20	3,630	7.70	6,540
3.20	302	4.80	1,660	6.30	3,800	7.80	6,760
3.30	347	4.90	1,775	6.40	3,980	7.90	6,980
3.40	397	5.00	1,890	6.50	4,160	8.00	7,200
3.50	453						

"Note.—The above table is applicable only for open-channel conditions. It is based on eight discharge measurements made during 1905 and two during 1904. It is fairly well defined between gage heights 3 feet and 7.5 feet. The table has been extended beyond these limits. Below 3 feet the table is based on two measurements at 2 feet. The application of this table for 1904 introduces a possible error of 10 to 20 per cent. in estimates."

Estimated Monthly Discharge of North Branch of Potomac River at Piedmont, W. Va., for 1904-5.

(Drainage area, 406 square miles.)

Month	Discharge in second-feet			Run-off.	
	Max.	Min.	Mean	Second-feet per square mile	Depth in inches
*1904.					
January	4,720	110	643	1.58	1.82
February	3,630	224	795	1.96	2.11
March	4,340	484	1,433	3.53	4.07
April	2,195	372	937	2.31	2.58
May	3,210	302	792	1.95	2.25
June	786	134	392	.966	1.08
July	425	60	160	.394	.454
August	99	9	37	.091	.105
September	30	6	17	.042	.047
October	68	12	28	.069	.080
November	51	15	34	.084	.094
December	1,660	15	243	.599	.691
The year	4,720	6	459	1.131	15.381
1905.					
January	3,210	99	360	.887	1.02
February	484	99	232	.571	.595
March	7,420	282	2,484	6.12	7.06
April	830	161	585	1.44	1.61
May	1,914	191	496	1.22	1.41
June	1,605	242	588	1.45	1.62
July	2,460	161	653	1.61	1.86
August	1,775	88	376	.926	1.07
September	1,020	51	195	.480	.536
October	1,718	36	348	.857	.988
November	1,385	148	267	.658	.734
December	2,895	208	815	2.01	2.32
The year	7.420	36	617	1.52	20.823

* 1904 estimates may be too low by 10 to 20 per cent.

"Note.—Ice conditions unknown; discharge applied as for open channel."

Discharge Measurements of North Branch of Potomac River at Piedmont, W. Va., in 1906.

Date.	Hydrographer.	Width Feet	Area of section. Sq. feet	Gage height. Feet	Discharge Sec.-Ft.
March 16	Bolster and Padgett	146	243	3.51	412
March 30	Robert Follansbee	291	1,220	7.15	5,820
April 11	R. H. Bolster	284	787	5.64	2,590
May 28	Robert Follansbee	147	243	3.49	391

Daily Gage Height, in Feet, of North Branch of Potomac River at Piedmont, W. Va., for 1906.

(Charles H. Beck, Observer.)

Day.	Jan.	Feb.	Mar.	Apr.	May	June	July
1	3.55	3.65	2.75	6.05	4.0	3.25	3.0
2	3.35	3.55	3.1	5.55	3.9	3.45	2.9
3	3.65	3.2	3.3	5.7	4.0	3.3	2.8
4	5.65	3.4	5.15	6.0	3.8	3.1	2.8
5	5.3	3.5	4.35	6.15	3.7	3.3	3.1
6	4.6	3.0	3.95	6.8	3.6	4.6	2.85
7	3.9	3.1	3.8	5.7	3.7	5.25	2.75
8	4.05	3.1	3.8	5.05	3.6	4.7	2.6
9	3.65	3.1	3.7	5.15	3.5	4.1	2.6
10	3.55	2.9	3.6	6.45	3.5	3.65	2.6
11	3.55	2.75	3.4	5.5	3.4	3.35	2.5
12	3.7	2.85	3.6	5.45	3.4	3.1	2.65
13	3.95	3.0	3.5	4.55	3.3	3.25	2.6
14	3.8	3.05	3.5	4.45	3.2	3.1	2.6
15	3.8	3.0	3.5	6.15	3.2	3.0	2.55
16	3.95	2.75	3.5	5.45	3.1	3.0	.....
17	4.15	2.8	3.4	4.85	3.1	2.9	.....
18	4.1	2.9	3.15	4.45	3.0	2.9	.....
19	4.7	2.8	3.4	4.25	3.0	2.9	.....
20	4.35	2.95	4.05	4.1	2.9	2.95	.....
21	4.5	3.0	3.8	3.95	2.9	3.1	.....
22	4.85	3.2	3.7	4.0	2.8	3.3	.....
23	8.2	3.1	3.7	4.0	2.8	3.2	.....
24	6.4	3.05	3.75	4.0	2.7	3.1	.....
25	5.1	3.1	3.55	4.1	2.7	3.0	.....
26	4.6	3.1	3.6	6.5	2.7	3.0	.....
27	4.35	3.05	5.05	5.4	2.7	3.6	.....
28	4.3	2.6	7.3	4.65	3.35	3.35	.....
29	4.15	.....	6.25	4.35	3.45	3.25	.....
30	3.95	.....	7.4	4.15	3.2	3.0	.....
31	3.8	.....	7.4	.....	..0	.....	.....

"Note.—Discharge probably unaffected by ice during 1906."

Rating Table for North Branch of Potomac River at Piedmont, W. Va., for 1906.

Gage height. Feet.	Discharge. Sec.-Ft.	Gage height. Feet.	Discharge. Sec.-Ft.	Gage height. Feet.	Discharge. Sec.-Ft.	Gage Height Feet.	Discharge Sec.-Ft.
2.50	70	3.70	519	4.90	1,655	6.20	3,450
2.60	88	3.80	587	5.00	1,770	6.40	3,785
2.70	109	3.90	661	5.10	1,890	6.60	4,140
2.80	133	4.00	740	5.20	2,015	6.80	4,515
2.90	160	4.10	825	5.30	2,140	7.00	4,900
3.00	190	4.20	915	5.40	2,270	7.20	5,300
3.10	224	4.30	1,010	5.50	2,400	7.40	5,710
3.20	262	4.40	1,110	5.60	2,535	7.60	6,130
3.30	304	4.50	1,215	5.70	2,675	7.80	6,570
3.40	350	4.60	1,320	5.80	2,820	8.00	7,030
3.50	401	4.70	1,430	5.90	2,970	8.20	7,500
3.60	457	4.80	1,540	6.00	3,125		

"Note.—The above table is applicable only for open-channel conditions. It is based on 3 discharge measurements made during 1906, and on the form of previous curves. It is well defined between gage heights 3.5 feet and 5.5 feet."

Monthly Discharge of North Branch of Potomac River at Piedmont, W. Va., for 1906.

(Drainage area, 410 square miles.)

Month.	Discharge in second-feet.			Run-off.	
	Maximum	Minimum	Mean.	Sec.-ft. per sq. mile.	Depth in inches.
January	7,500	327	1,260	3.06	3.53
February	488	88	220	.537	.56
March	5,710	121	1,160	2.83	3.26
April	4,520	700	2,010	4.91	5.48
May	740	109	323	.788	.91
June	2,080	160	413	1.01	1.13
July 1-15	224	70	120	.293	.16

"Note.—Values are rated as follows: January, February, and July, good; March to June, excellent."

At Cumberland, Maryland, a gaging station was kept on the North Branch of Potomac River by the United States Geological Survey from June 11, 1894, to November 20, 1897, the results for the years 1895, 1896, and 1897 having been assembled from the various Government reports and published as a unit in the Report of the Maryland Geological Survey on the Geology of Allegany County, pages 235-240, the description of the station and the records as taken from that volume, being as follows:

"The only systematic series of observations of flow of water within or near Allegany County has been that made at Cumberland, the results of which have been given from time to time in the reports of the Division of Hydrography of the United States Geological Survey. Observations of river height were begun on June 11, 1894, at the West Virginia Central Railroad bridge about 200 yards below the dam on the Potomac. The gage was a vertical rod 10 feet long, bolted to the east end of the abutment of the head-gates above the dam. The channel consists of loose rocks and did not change notably. The discharge measurements were made from the bridge. Measurements were made not only of the discharge of the river but also of the amount of water taken out above the dam by the feeder of the Chesapeake and Ohio Canal. On June 5, 1895, when there were 216 cubic feet per second, or second-feet, in the river, there were in the canal feeder 40 second-feet. On June 6 the river discharged 530 second-feet and the canal feeder carried 79 second-feet; on June 13 the river discharged 149 second-feet and the canal feeder carried 38 second-feet; on July 17 the river discharged 266 second-feet and the canal feeder carried 79 second-feet. Measurements were continued through 1896, the results being shown on pages 22-24 of the Eighteenth Annual Report, Part IV, of the United States Geological Survey. Observations were discontinued in November, 1897.

"The following tables give the daily gage height as observed during the years 1895, 1896, and 1897:

Daily Gage Height of North Branch of Potomac River at Cumberland, Md., for 1895.

Day	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Dec.
1	3.00	3.60	6.00	3.90	3.40	3.00	3.10	2.80	1.00	.....
2	3.00	3.60	5.70	3.80	3.80	3.00	3.40	2.70	1.00	.....
3	3.00	3.50	4.90	4.40	3.80	3.00	3.30	2.70	1.00	.....
4	3.00	3.50	4.60	3.90	3.60	2.90	3.10	2.70	1.90	.....
5	3.00	3.50	4.20	3.80	3.60	2.90	3.10	2.70	1.90	.....
6	3.10	3.50	4.00	3.70	3.40	3.00	3.20	2.60	1.90	.....
7	4.80	3.50	3.80	3.60	3.30	3.00	3.20	2.60	1.80	.....
8	6.00	3.50	3.80	3.80	3.20	3.00	3.20	2.60	0.80	.....
9	4.80	3.50	4.20	5.60	3.40	2.90	3.30	2.50	0.70	.....
10	4.70	3.50	4.00	5.50	3.20	2.90	3.70	2.50	0.50	.....
11	4.10	3.50	4.00	4.70	3.20	2.90	3.40	2.40	0.50	.....
12	3.80	3.40	3.80	4.70	3.70	2.80	3.20	2.40	0.60	.....
13	3.50	3.40	3.80	3.90	3.70	2.80	3.20	2.40	1.10	.....
14	3.50	3.40	4.50	3.80	3.70	3.30	3.30	2.30	1.20	.....
15	3.50	3.40	4.80	3.80	3.50	3.30	3.30	2.20	1.00	.....
16	3.90	3.30	5.20	3.80	3.30	3.20	3.30	2.10	0.90	.....
17	3.90	3.40	4.70	3.80	3.40	3.20	3.00	2.00	0.90	.....
18	3.90	3.40	4.50	3.70	3.40	3.10	3.00	1.90	0.80	.....
19	3.80	3.40	4.30	3.60	3.40	3.00	2.90	1.80	0.70	.....
20	3.80	3.40	4.10	3.50	3.30	3.00	2.90	1.70	0.50	.....
21	3.90	3.40	3.80	3.40	3.40	2.90	2.70	1.60	0.40	.....
22	4.60	3.40	3.70	3.40	3.40	3.00	2.70	1.30	0.30	3.00
23	4.00	3.40	3.70	3.30	3.40	3.00	2.70	1.20	0.20	3.20
24	3.70	3.40	3.70	3.30	3.40	3.00	2.70	1.10	0.10	2.90
25	3.60	3.40	3.70	3.20	3.30	2.90	2.70	1.00	(a)	2.90
26	3.50	3.60	4.50	3.30	3.20	3.00	2.70	0.90	.....	3.00
27	3.50	4.10	4.30	3.30	3.30	3.00	2.70	0.90	.....	2.90
28	3.40	5.00	4.30	3.30	3.20	3.30	2.80	0.90	.....	2.90
29	3.40	.....	5.10	3.30	3.10	3.20	2.90	0.90	.....	2.90
30	3.70	.....	4.50	3.40	3.10	3.00	2.90	0.80	.....	3.10
31	3.70	.....	4.50	.....	3.10	.....	2.80	0.90	.....	3.00

(a) Water 5 inches below gage. Readings discontinued until December 22.

Daily Gage Height of North Branch of Potomac River at Cumberland, Md., for 1896.

Day	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.90	4.60	3.90	5.00	4.50	3.60	3.10	3.80	2.60	5.50	3.10	3.70
2	2.90	4.80	3.70	4.80	4.50	3.50	3.10	3.80	2.70	4.50	3.10	3.50
3	3.00	4.00	3.00	4.40	4.50	3.40	3.10	3.80	2.70	4.50	3.10	3.40
4	2.90	3.80	3.30	4.20	4.50	3.50	3.10	3.70	2.70	3.50	3.20	3.30
5	2.90	3.80	3.10	3.80	3.40	3.30	3.10	3.30	2.70	3.40	3.20	3.30
6	2.90	3.80	3.10	3.80	3.30	3.30	2.90	3.30	2.80	3.30	5.50	3.30
7	2.90	4.50	3.10	3.70	3.10	3.80	2.90	3.20	2.90	3.10	4.50	3.30
8	2.90	3.90	3.60	3.70	3.00	3.70	2.90	3.20	2.90	3.10	3.80	3.20
9	2.90	3.00	3.40	3.70	3.00	3.40	3.10	3.40	2.90	3.10	3.80	3.30
10	2.90	3.40	3.30	3.70	3.00	3.40	3.70	3.40	2.90	3.00	3.70	3.30
11	2.90	3.10	3.30	3.70	2.90	3.40	3.40	3.30	2.80	3.00	3.60	3.40
12	3.00	3.30	3.40	4.30	2.90	3.40	3.30	3.30	2.70	3.10	3.50	3.60
13	3.00	4.90	3.10	4.30	3.50	3.20	3.10	3.10	2.90	3.10	3.50	3.40
14	3.00	4.10	3.10	4.10	3.50	3.20	3.00	3.60	3.00	3.00	3.40	3.30
15	3.00	3.80	3.10	3.90	3.30	3 30	3.00	3.50	3.10	3.00	3.20	3.30

Daily Gage Height of North Branch of Potomac River at Cumberland, Md., for 1896—(Continued).

Day	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
16	3.00	3.80	3.20	3.80	3.20	3.30	3.00	3.30	3.50	3.00	3.10	3.30
17	3.00	3.50	3.30	3.80	3.10	3.70	3.00	3.10	3.00	3.00	3.10	3.30
18	3.00	3.50	3.30	3.70	3.40	4.10	3.30	3.00	3.00	3.00	3.20	3.30
19	2.90	3.20	3.50	3.50	3.50	3.70	3.10	2.90	3.00	2.90	3.30	3.30
20	2.90	3.20	3.60	3.50	3.80	3.60	3.10	2.90	2.90	2.90	3.30	3.30
21	3.00	3.20	3.70	3.50	3.80	3.30	3.30	3.00	3.00	3.10	3.20	3.20
22	3.00	3.20	3.70	3.50	3.60	3.30	4.00	3.00	3.10	3.10	3.30	3.20
23	3.00	3.30	4.00	3.30	3.40	3.20	4.70	3.00	3.10	3.10	3.30	3.20
24	3.10	3.10	3.90	3.40	3.40	3.50	4.60	3.20	3.00	3.30	3.40	3.20
25	3.50	3.30	3.70	3.50	3.50	3.50	10.00	3.00	3.00	3.70	3.30	3.20
26	3.30	3.30	4.00	3.50	3.50	3.60	6.50	2.90	3.00	3.50	3.30	3.20
27	3.10	3.30	5.00	3.50	4.00	3.50	4.70	2.90	3.00	3.20	3.20	3.10
28	3.00	3.20	4.50	3.50	3.70	3.30	4.90	2.90	2.90	3.20	3.20	3.10
29	3.00	3.70	5.80	3.50	4.10	3.30	4.50	2.90	2.90	3.10	3.90	3.10
30	3.70	.....	8.00	3.40	4.00	3.20	4.50	2.90	10.00	3.10	4.00	3.10
31	4.20	.....	6.00	.....	3.80	.....	4.50	.....	.....	3.10	.....	3.20

Daily Gage Height of North Branch of Potomac River at Cumberland, Md., for 1897.

Day	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
1	3.20	3.40	4.00	3.50	3.50	2.90	2.70	3.00	2.60	2.20	2.80	.....
2	3.20	3.50	3.80	3.40	7.50	2.80	2.70	3.00	2.50	2.00	3.00	.....
3	3.30	3.60	3.90	3.40	5.50	2.80	2.70	2.90	2.50	1.90	3.00	.....
4	3.30	3.40	5.20	3.70	5.00	2.80	2.70	2.90	2.50	1.70	3.10	.....
5	4.00	3.40	4.90	3.80	4.60	2.80	2.70	3.50	2.40	1.70	3.00	.....
6	4.00	3.50	6.00	3.70	4.10	2.80	2.60	3.20	2.40	1.60	2.90	.....
7	3.70	4.50	5.00	3.60	4.10	2.80	2.60	3.10	2.20	1.50	2.90	.....
8	3.40	4.20	4.40	5.20	3.90	2.80	2.70	3.20	1.90	1.40	3.00	.....
9	3.30	4.00	4.60	5.40	3.70	2.90	2.70	3.10	1.80	1.40	4.00	.....
10	3.40	3.70	4.20	4.50	3.70	2.70	2.70	3.00	1.80	1.50	3.40	.....
11	3.20	3.60	4.00	4.50	3.60	2.70	2.80	3.00	1.70	1.30	3.40	.....
12	3.20	3.50	4.00	4.10	4.00	2.70	2.90	2.90	1.60	1.30	3.30	.....
13	3.20	3.70	3.90	4.00	4.40	2.60	2.90	2.90	1.50	1.30	3.20	.....
14	3.20	4.00	3.80	3.80	5.40	2.50	2.80	2.80	1.40	1.40	3.20	.....
15	3.20	4.20	4.00	3.90	4.60	2.50	2.80	3.00	1.30	1.50	3.50	.....
16	3.20	4.70	3.80	3.90	4.30	3.00	2.80	3.00	1.20	1.50	3.50	.....
17	3.40	4.50	3.70	3.70	3.90	3.00	2.70	2.90	1.20	1.40	3.40	.....
18	3.70	5.00	4.00	3.70	3.80	2.90	2.80	2.80	3.20	1.40	3.30	.....
19	3.50	4.80	4.50	3.60	3.70	2.90	2.80	2.90	3.00	1.40	3.30	.....
20	3.40	3.50	4.80	3.70	3.50	2.90	2.90	2.90	2.90	1.40	3.20	.....
21	3.40	3.50	4.60	3.50	3.30	3.00	3.20	2.90	2.80	1.40	.....	.....
22	3.50	10.50	4.20	3.30	3.30	3.00	3.00	2.90	2.70	1.30	.....	.....
23	3.40	8.70	4.00	3.30	3.30	2.90	3.00	2.90	2.60	1.30	.....	.....
24	3.40	6.20	4.20	3.30	3.00	2.90	3.00	2.90	2.80	1.50	.....	.....
25	3.30	5.10	4.10	3.20	3.00	3.00	3.00	2.90	3.00	1.60	.....	.....
26	3.30	4.50	4.00	3.10	3.00	2.90	2.90	3.00	3.00	1.60	.....	.....
27	3.30	4.30	3.90	3.00	3.00	2.90	3.20	3.00	2.90	1.70	.....	.....
28	3.30	4.00	3.80	3.00	3.00	2.90	3.10	3.00	2.80	1.70	.....	.....
29	3.30	.....	3.70	3.00	2.90	2.90	3.10	2.90	2.80	2.40	.....	.....
30	3.30	.....	3.60	2.90	2.90	2.80	3.10	2.80	2.70	2.70	.....	.....
31	3.30	.....	3.60	.....	2.90	.....	3.00	2.60	.....	2.70	.....	.....

List of Discharge Measurements made on North Branch of Potomac River at Cumberland, Md.*

No.	Date	Hydrographer	Meter Number	Gage Height Feet	Area of Section. Sq. Ft.	Mean Velocity Ft. per Sec.	Discharge. Second-feet
	1894						
1	May 24	C. C. Babb	23	.....	1,166	2.60	3,037
	1895						
2	Mar. 30	C. C. Babb	29L	4.50	1,088	3.17	3,446
3	Apr. 10	C. C. Babb	29L	5.40	1,560	3.88	6,054
4	Apr. 25	C. C. Babb	29h	3.30	423	1.49	630
5	May 3	C. C. Babb	29h	3.75	722	2.39	1,728
6	May 9	C. C. Babb	29h	3.40	465	1.67	777
7	May 23	C. C. Babb	29h	3.40	569	1.46	831
8	June 5	C. C. Babb	29h	2.95	373	0.69	256
9	June 6	C. C. Babb	29h	3.10	445	1.37	609
10	June 13	C. C. Babb	29h	3.00	334	0.86	287
11	July 17	C. C. Babb	76	3.05	357	0.97	345
	1896						
12	June 24	D. C. Humphreys	W. B.	3.31	580	1.42	822
13	Aug. 6	D. C. Humphreys	W. B.	3.30	355	1.71	605
14	Nov. 18	A. P. Davis	68	3.38	577	1.33	765
	1897						
15	Feb. 10	A. P. Davis	.....	3.75	.....	.....	1,307
16	Mar. 27	A. P. Davis	.....	3.93	.....	.....	1,995
17	June 25	A. P. Davis	.....	3.00	.....	.....	425
18	Sept. 1	A. P. Davis	.....	2.60	.....	.....	86
19	Sept. 22	A. P. Davis	.....	2.70	.....	.....	92

* Gagings include discharge of canal feeders.

Rating Tables for North Branch of Potomac River at Cumberland, Md., 1895, 1896, and 1897.

Gage Height in feet	Discharge in second-feet			Gage Height in feet	Discharge in second-feet		
	1895.	1896.	1897.		1895	1896.	1897.
2.7	160	160	110	4.3	3,070	3,070	3,015
2.8	200	200	140	4.4	3,325	3,325	3,295
2.9	250	240	180	4.5	3,580	3,580	3,575
3.0	325	300	255	4.6	3,835	3,835	3,855
3.1	425	400	375	4.7	4,090	4,090	4,135
3.2	525	500	525	4.8	4,345	4,345	4,415
3.3	650	650	680	4.9	4,600	4,600	4,695
3.4	800	800	835	5.0	4,855	4,855	4,975
3.5	1,030	1,000	990	5.2	5,365	5,365	5,535
3.6	1,285	1,285	1,165	5.5	6,130	6,130	6,375
3.7	1,540	1,540	1,365	6.0	7,405	7,405	7,775
3.8	1,795	1,795	1,615	7.0	.....	.....	10,575
3.9	2,050	2,050	1,895	8.0	.....	.....	13,375
4.0	2,305	2,305	2,175	9.0	.....	.....	16,175
4.1	2,560	2,560	2,455	10.0	.....	.....	18,975
4.2	2,815	2,815	2,735	11.0	.....	.....	21,775

Estimated Monthly Discharge of North Branch of Potomac River at Cumberland, Md.

(Drainage area, 891 square miles.)

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Depth in inches.	Second-feet per square mile.
1895.					
January	7,405	325	1,844	2.39	2.07
February	4,855	650	1,128	1.32	1.27
March	7,405	1,540	3,185	4.12	3.57
April	6,385	525	1,875	2.35	1.10
May	1,795	425	870	1.13	0.98
June	650	200	355	0.45	0.40
July	1,540	160	431	0.55	0.48
1896.					
January	2,815	240	438	0.56	0.49
February	4,600	400	1,498	1.81	1.68
March	12,505	300	1,991	2.57	2.23
April	4,855	650	1,792	2.24	2.01
May	3,580	240	1,351	1.75	1.52
June	2,560	500	1,396	1.75	1.57
July	17,600	300	2,141	2.77	2.40
August	1,795	200	656	0.85	0.74
September	17,600	140	859	1.07	0.96
October	6,130	240	868	1.12	0.97
November	6,130	400	1,116	1.39	1.25
December	1,540	400	654	0.84	0.73
The year	17,600	140	1,230	18.72	1.38
1897.					
January	2,175	525	836	1.08	0.94
February	20,375	835	3,610	4.21	4.05
March	7,775	1,165	2,744	3.55	3.08
April	6,095	180	1,570	1.96	1.76
May	11,975	180	2,162	2.79	2.42
June	255	80	165	0.21	0.19
July	525	85	199	0.25	0.22
August	990	85	256	0.33	0.29
September (a)	525	10	70	0.09	0.08
October (a)	110	20	40	0.04	0.04

(a) Approximate.

Greenspring Creek.—Greenspring Creek is a short southern tributary of North Branch, emptying at Green Spring Station, its entire drainage area being in Hampshire County.

Dan Run.—Dan Run is a short, southern branch, rising along the Mineral-Hampshire County Line and emptying into North Branch at Dans Run Station, its entire length being 3.82 miles and the area of its drainage basin 4.60 square miles.

Patterson Creek.—Patterson Creek, tributary to the south side of North Branch at Patterson Creek Station, rises in Grant County just south of Lahmansville and flows northeastward closely parallel to Patterson Creek Mountain and Patterson Creek Ridge, its total length being 48.09 miles and

its total fall from head to mouth 900 feet, making a rate of 18.71 feet per mile. The area of its drainage basin is 283.2 square miles. As shown by the figures it is a sluggish stream, approaching maturity, and as the topographic map indicates, its valley is wide and there are numerous meanders of recent origin. Owing to the proximity of the mountains named above, this creek has few tributaries of consequence on its eastern side, Beaver and Elliber Runs being exceptions, but on the west there is a large gathering area, the principal streams, in ascending order, being Plum, Turners, Cabin, and Staggs Runs, Mill Creek, Mikes, Rosser, and Thorn Runs, North Fork and Middle Fork.

Evitts Creek.—Evitts Creek is a considerable tributary from the north, rising in Pennsylvania, flowing southwestward across Maryland and emptying into North Branch 2½ miles southeast of Cumberland.

Wills Creek.—Wills Creek is a large tributary from the north, rising in Pennsylvania, flowing across Maryland and reaching North Branch at Cumberland. Gaging records of this stream for certain years are available in the Water-Supply Papers of the United States Geological Survey.

New Creek.—New Creek, tributary to the south side of North Branch at Keyser, rises in Grant County four miles north of Greenland Gap and flows northeastward across Mineral, its total length being 17.66 miles and the area of its drainage basin 53 square miles. Its total fall from head to mouth is 1,200 feet, making a rate of 67.95 feet per mile. Throughout most of its course this creek lies at the foot of New Creek Mountain which at most points rises abruptly from the water's edge. On the west between Keyser and the Grant County Line there is a fertile valley varying from one-fourth to three-fourths mile in width, the low foot-hills of the Allegheny Front rising in successive stages farther west, the mountain being at no point distant more than three miles from the creek. This stream is less mature than Patterson Creek, there being no meanders of ancient or recent origin, and the current being not quite so gentle.

Georges Creek.—Georges Creek rises in Pennsylvania, flows southwestward across Maryland between Dans and Big Savage Mountains and empties into North Branch at Westernport, opposite Piedmont. Gaging records of this stream for certain years are available in the Water-Supply Papers of the United States Geological Survey.

Savage River.—Savage River, one of the major tributaries of North Branch from the northern side, rises in Garrett County, Maryland, flows southwestward to the southern

extremity of Big Savage Mountain, and then cutting a gap between Big Savage and Backbone Mountains turns sharply to the southeast and empties at Bloomington. Gaging records of this stream for certain years are available in the Water-Supply Papers of the United States Geological Survey.

Abram Creek.—Abram Creek, a southern tributary of North Branch, rises in Grant County 1½ miles southeast of Bismarck, flows generally northward by a tortuous channel and empties at Harrison, Mineral County. Its total length from head to mouth is 18.79 miles and its total fall 1,565 feet, making a rate of 83.29 feet per mile. The area of its drainage basin is 44.50 square miles. Its present cycle is comparatively youthful, there being high valley walls with no bottom lands of consequence, its wide meanders being clearly of ancient origin, dating back to a previous stage of peneplanation. Its principal tributaries are Emory and Johnnycake Runs.

Stony River.—Stony River, the largest tributary of North Branch from the south, rises at the Grant-Tucker County Line eight miles southeast of Davis, flows northeastward by a winding channel and empties at the corner of Grant, Mineral and Garrett Counties, 1.3 miles southwest of Schell. Its total length from head to mouth is 25.25 miles and its total fall 1,655 feet, making a rate per mile of 65.54 feet. The area of drainage basin is 59.29 square miles. Throughout almost its entire course this river is a turbulent, rocky stream, the current on its headwaters only being sluggish. Its immediate valley is almost entirely uninhabited, there being no smooth bottom lands, but on the uplands to the east there is a sparsely settled community. Its principal tributaries are Mill, Laurel, and Helmick Runs, all entering from the east and being named in ascending order. No gaging records of this river have been kept by any public agency.

Difficult Creek.—Difficult Creek is a short, turbulent, southern tributary emptying one mile below Steyer, its total length being 4.36 miles and its total fall 700 feet, making a rate of 160.55 feet per mile, and its drainage area being 7.58 square miles.

Glade Run.—Glade Run rises in Garrett County, Maryland, flows generally southward and empties into North Branch between Steyer and Gormania, being sluggish along its upper waters but having a swift current on the lower mile and a half of its course.

Buffalo Creek.—Buffalo Creek rises along Dobbin Ridge at the line between Grant and Tucker Counties, flows northward and empties into North Branch at Bayard, its total

length being 5.18 miles, its total fall 900 feet, making a rate of 173.75 feet per mile, and the area of its drainage basin 10.08 square miles. Little Buffalo Creek is its main tributary.

Red Oak Creek.—Red Oak Creek rises against Dobbin Ridge, flows northward and empties into North Branch at Henry, its total length being 3.63 miles, its total fall 700 feet, making a rate of 192.84 feet per mile, and the area of its drainage basin 3.12 square miles. Its watershed is entirely uninhabited.

South Branch of Potomac River.

South Branch of Potomac River, which with some of its branches drains the southern end of Grant County, rises near Monterey, Highland County, Virginia, flows generally northeastward across Pendleton, Grant, Hardy, and Hampshire Counties, West Virginia, and joins with North Branch to form the main Potomac near French Station (South Branch P. O.). Its total length from source to mouth is 131.15 miles, its total fall 3,065 feet, making a rate of 23.37 feet per mile, but from its head to the Hardy County Line the rate is 42.91 feet per mile and from that point to its mouth only 5.23 feet per mile. The area of its drainage basin is 1,492.66 square miles. From the Pendleton County Line to the mouth of North Fork (of South Branch), its course is northeastward through a rugged, narrow valley for 11.5 miles between Cave and North Fork Mountains, there being numerous entrenched meanders and a comparatively rapid current. At the mouth of North Fork it turns eastward for 10.5 miles across the structural strike of the rocks and makes several picturesque gaps in the topography. About one mile eastward from Durgon, Hardy County, it again turns northeastward and follows for many miles through a synclinal valley in Hardy and Hampshire Counties along which the soft shales of the Middle Devonian form wide bottom lands of great agricultural value. In the vicinity of Petersburg, Grant County, also, there is another stretch of wide valley formed in the same shales and four miles in length by one mile in width.

From the mouth of North Fork to the main Potomac at French the South Branch is characterized by numerous conspicuous terraces, the same having been previously described, pages 33 to 40.

Its principal tributaries in Grant County, in ascending order, are Mill Creek, Lunice Creek, and North Fork.

Gaging records along the South Branch have been kept only at one point, near Springfield, Hampshire County, and as this is many miles below the Grant County Line after the flow of the river has been augmented by South Fork and other

tributaries, the hydrographic data would have little bearing on the territory of this Report. The records of this station, however, are published in various Water-Supply Papers of the United States Geological Survey.

Mill Creek.—Mill Creek, emptying into the south side of South Branch 1½ miles below Petersburg, is composed of two branches known as North Mill Creek and South Mill Creek, respectively, that join currents only 2½ miles above the mouth of the parent stream, the entire drainage area of Mill Creek and the two branches being 103.66 square miles. **North Mill Creek** rises in Pendleton County just north of Kline, flows northeastward and joins South Mill Creek at Hiser, its length being 16.13 miles, its total fall 1,160 feet, making a rate of 71.92 feet per mile, and the area of its drainage basin 47.42 square miles. Its current is gentle, there being a narrow valley with many short meanders of recent origin. **South Mill Creek** rises in Pendleton County 2½ miles northeastward from Kline, flows northeastward to Rough Run and thence almost northward to the junction with North Mill Creek, its length being 14.01 miles, its total fall 600 feet, making a rate of 42.83 feet per mile, and the area of its drainage basin 46.71 square miles. Its valley is of about the same width as that of North Mill Creek and the current of the stream is much the same.

Lunice Creek.—Lunice Creek heads against the base of the Allegheny Front in Grant County five miles west of Maysville, flows eastward by a tortuous course, cutting the Cosner Gap through New Creek Mountain and the Mays Gap through Knobly Mountain, then turns southeastward and empties into South Branch at the eastern edge of Petersburg. Its total length from head to mouth is 19.78 miles, its total fall 1,600 feet, making a rate of 80.89 feet per mile, and the area of its drainage basin 88.67 square miles. Its principal tributaries, in ascending order, are Robinson, Norman, and Brushy Runs and South Fork. Along its upper valley the current is swift but below South Fork the valley widens and there are recent meanders.

North Fork of South Branch.—North Fork of South Branch rises in Highland County, Virginia, about eight miles northwest of Monterey, flows northeastward by an almost airline course, there being a few entrenched meanders along its lower course, through Pendleton County and into Grant to the mouth of Jordan Run 1½ miles below Hopeville. At this point it turns eastward, cuts a magnificent gap through the range known as New Creek Mountain to the north and North Fork Mountain to the south, makes another gap through the

southern end of Knobly Mountain, and empties into South Branch four miles west of Petersburg. Its total length is 42.22 miles, its total fall 1,560 feet, making a rate of 36.95 feet per mile, and the area of its drainage basin is 326.06 square miles. Its valley lies between lofty mountain ranges, its tributary drainage being mainly short streams, Jordan Run in Grant County and Seneca Creek in Pendleton County, the latter stream having cut gorges through several high ridges to reach North Fork, being exceptions. In both Grant and Pendleton Counties it has a narrow valley that at times is gorge-like, its current being moderate at most points.

PART II.

Geology.

CHAPTER III.

GEOLOGIC HISTORY AND CORRELATION OF ROCKS.

DERIVATION OF SEDIMENTS.

The outcropping arenaceous rocks of Mineral and Grant Counties are entirely of sedimentary, or clastic, origin. They represent the broken and pulverized remains of still older rocks of the earth that have been slowly torn to bits, mainly by the agency of meteoric water, but also in part by atmospheric or chemical action, the whole process having been materially aided and hastened by diastrophism which both wrinkled and crushed the ancient surface. From their original position these rock fragments have been transported long distances by the prehistoric rivers that had their sources in a great mountain range, often called **Appalachia** for convenience, that is known to have existed in the present vicinity of the Atlantic seaboard and in the region immediately westward, and that must have been of great height to afford the necessary gradient required for carrying the sediments to their present position. From this ancient land of high relief a vast quantity of rock debris was carried eastward and deposited in the Atlantic Ocean, forming what is known as the Continental Shelf, the peculiarities of which are largely unknown because of its present submergence. At the same time another large mass of sediment was carried westward toward the Mississippi Valley and deposited in the ancient Appalachian

Sea that extended from the Gulf region northward into Canada, the waters of which were comparatively shallow, with many large embayments of brackish or fresh constituents due to the inflow from the rivers.

As the burden of sediment increased in this old basin its floor gradually subsided, allowing fresh deposits to cover those already made, and at the same time causing isostatic adjustments which raised new lands in the region of Appalachia and also uplifted portions of the newly formed beds just west of the original land area, affording further material for the old rivers to tear down and transport. This process of alternate uplift and erosion continued for well-nigh infinite ages until now the primeval mountains have been entirely degraded, leaving nothing but their ancient stumps deeply buried under a mantle of much later accumulation in the Piedmont and Coastal Plain provinces, the high ridges of Appalachia having moved slowly westward by successive upheavals until they now occupy their present positions in the eastern portion of the ancient Appalachian Sea.

The sum total of sediments now accumulated on the old floor of the Appalachian Basin is variously estimated from 40,000 to 60,000 feet, consisting in part of the sandy remains of Appalachia, which by differential sorting of the fragments have been separated into sandy beds composed of the coarser quartzitic portions of the old granites, accumulated near the source of the waters or else much farther westward at times of excessive flow; and into shales composed of those portions in which alumina and the finer sand grains predominated, allowing them to be carried farther into the basin or deposited along its edge during periods in which the waters flowed gently.

The calcareous sediments, in which lime predominates, and which form a considerable fraction of the surface rocks of Mineral and Grant Counties, are derived from the remains of vast quantities of animal organisms which flourished in the Appalachian Sea or in its shallow embayments of fresher water during periods in which degradation from Appalachia was not active and the waters were clear. A large amount of this material still remains approximately in its original position, but some portions have been transported for comparatively short distances and have been contaminated in part by mixture with sand or silt from the rivers of Appalachia.

Another small fraction of the surface rocks of the two counties is composed of the coals, which represent the accumulation of vegetable matter that grew in extensive swamps during periods when the basin floor was elevated almost to

the surface of the water, affording the peculiar condition in which plants might grow and at the same time be preserved from oxidation as the land gently subsided. A further more rapid subsidence caused these beds of vegetable remains to be buried under a mantle of sand and shale, thus preserving them until heat and pressure could gradually drive out the moisture and consolidate them into coal. That swampy conditions, caused by alternate periods of elevation and depression, prevailed at numerous periods is evident from the fact that there are now numerous distinct beds of coal in the two counties, each of which represents an ancient swamp. That some of these swamps were of long duration is also evident from the thickness of the coals, the Pittsburgh, or "Big Vein," alone being from twelve to twenty feet in thickness, and formed from the compression of a vast amount of vegetable debris.

CYCLES OF UPLIFT AND EROSION.

The arenaceous, calcareous, and bituminous sediments of the two counties, subsequent to their original deposition as described above, have been deformed, both during the periods of their formation and in more recent times. As detailed under the subject of "Evolution of Mountain Forms," pages 28-30, four distinct cycles of uplift and erosion have occurred in the Potomac sector of the Appalachian System, the present cycle having partly advanced through its erosional phase.

FAUNAL STAGES.

The oscillations of the early seas in the Appalachian Basin are reflected in the fossil life of the sediments deposited during the various periods of accumulation. Disregarding the Quaternary, or Alluvial, deposits which are entirely of recent, fresh-water origin, and starting with the Pennsylvanian Period, marine fossils have not been observed in the Monongahela Series but there are microscopic, fresh- or brackish-water forms, indicating that these rocks were deposited in lacustrine or embayment areas where the waters were either fresh or only slightly saline. In the Conemaugh, just below the Monongahela Series, the same conditions were prevalent in the upper half, but in the lower portion there are several thin zones, varying from a few inches to a few feet in thickness, where marine fossils are abundant, each indicating a brief interval of salt-water invasion, while the presence of abundant red sediments, often occurring both above and below the fossil zones, indicates that many of these beds were highly oxidated by long exposure to air at some time during their

progress from Appalachia to their present locations. In the Allegheny Series marine fossils have not been noted in the Mineral and Grant area but they are known to occur at one zone in western Pennsylvania and northeastern Ohio, indicating that these beds of Mineral and Grant were deposited in fresh or brackish water, and the entire absence of red sediments in this series precludes the possibility of any long exposure to air. In the Pottsville Series there are thin zones of marine accumulation in certain portions of the Appalachian Basin, very similar to those of the Conemaugh, except that red beds are entirely lacking. In Mineral and Grant, however, these marine zones almost entirely, if not completely, disappear, most of the fossils found being of brackish-water origin, giving rise to the belief that the Appalachian Sea of Pottsville time lay farther west and that fresh water largely prevailed in the Potomac region.

In the Mississippian Period marine fossils are exceedingly scarce in the Mauch Chunk Series, being found only in a few thin zones of limestone that occur at two or three planes in the red shales and micaceous sandstones that compose the series. These calcareous zones appear to be a more southern development, however, none of them being noted in Mineral and Grant. In the Greenbrier Limestone, occurring just below the Mauch Chunk, marine fossils are profuse and well distributed. So far as known they have not been sufficiently studied in the Appalachian region to be classified according to any zonal arrangement. In the Pocono Series, coming just below the Greenbrier, and composed almost entirely of coarse sandstones and sandy shales, fossils are almost unknown, the West Virginia phase having yielded them at only a few points entirely outside of the Mineral and Grant area.

In the Upper Devonian marine life had scanty, if any, existence in the Catskill Series of red shales and micaceous sandstones, there being one or two fossil zones in Tucker County that appear to be in the transitional beds between Catskill and Chemung. Of these the principal fossiliferous bed (Hendricks Sandstone) appears to be well represented in Mineral and Grant, but the red beds that come below it in Tucker have almost entirely disappeared. In the Chemung Series, which is distinctly of marine origin in the main regions of its occurrence in the Appalachian area of deposition, fossils are of comparatively limited occurrence in Mineral and Grant. They are found in the transitional Hendricks Sandstone at the top, at irregular zones, not definitely correlated as continuous, in the intermediate portions of the series, and frequently in grayish sandstones near the base. In the Portage

shales and thin sandstones, coming below the Chemung, fossils are of limited occurrence in the Appalachian region but were not noted in Mineral and Grant, their apparent absence affording the best line of distinction between this series and the Chemung.

In the Middle Devonian small fossils are occasionally noted in the black Genesee Shale but they are not conspicuous. In the Hamilton Shale they are abundant, being profusely evident in almost every foot of the series, and affording ideal conditions for the collector, owing to the ease with which they may be removed. In the Marcellus Series they are scarce in the black, fissile shale that comprises its main bulk but often occur in the double-bedded Lower Selinsgrove Limestone found in the lower portion.

In the Lower Devonian fossils are abundant, occurring in vast numbers in both the Oriskany Sandstone and in the Helderberg Limestone, zonal arrangements in both of these formations being apparently well defined.

In the Silurian marine life is almost wanting in the Bossardville Limestone and of only scanty occurrence in the Rondout Waterlime. In the Bloomsburg Red Shale, as might be expected, it is exceedingly scarce, although one distinctly fossiliferous stratum was found in the sandstone member of this group in Mineral County. In the Niagara Limestone fossils occur in profusion at all stages. In the Clinton Series they are abundant in the zone of iron ore near the top, and of more limited occurrence in the "Iron Sandstone" near the base. In the White Medina Sandstone, which is highly quartzitic and shows signs of incipient metamorphism, no fossils were found by the writer but a species of worm is noted by Dr. I. C. White near the top of this member. In the Red and Gray Medina shales and sandstones no marine life is evident. In the Ordovician, fossils are abundant in the exposed portion of the Martinsburg Shale. A good collection was made in the North Fork Gap west of Petersburg, which is the only easily accessible locality of its outcrop in the two counties.

PREVIOUS GEOLOGIC WORK.

Numerous general and special publications have been issued within the past century, sections and items of which are applicable to the geology, natural resources, history, and climate of Mineral and Grant Counties. These publications are summarized in the following bibliography, but the list is doubtless far from complete and apology is offered to writers who may have been overlooked. Water-Supply Papers of the United States Geological Survey, dealing with the Potomac

River and its tributaries, have already been noted under the description of that stream and its affluents, pages 52-74, and are not repeated:

1838.—**Douglas, D. B.** Report on the Coal and Iron Formation of Frostburg and Upper Potomac in the States of Maryland and Virginia. Sections, map, and analyses.

1839.—**Rogers, W. B.** Report of Progress of the Geological Survey (of Virginia) for the year 1839. (Reprinted under title of "Geology of the Virginias" by D. Appleton & Co., New York, in 1884) pp. 330-359 of reprint. Describes coals, etc., in what is now western Mineral and Grant Counties.

1840-1842.—**Rogers, W. B. & H. D.** On the Physical Structure of the Appalachian Chain, as Exemplifying the Laws which have Regulated the Elevation of Great Mountain Chains Generally. Transactions of the Association of American Geologists and Naturalists. (Reprinted in Geology of the Virginias, D. Appleton & Co. 1884, pp. 601-642.)

1843.—**Rogers, H. D.** An inquiry into the origin of the Appalachian Coal Strata, Bituminous and Anthracite. Trans. Association of American Geologists, 41 pp.

1850.—**Rogers, H. D.** On the Structural Features of the Appalachians, Compared wth those of the Alps and other Disturbed Districts of Europe. Proc. American Association for the Advancement of Science, Vol. II, 5 pp.

1853.—**Strother, D. H.** The Blackwater Chronicle, a Narrative of an Expedition into the Land of Canaan. By the Clerk of Oxenforde, D. H. Strother, 223 pp. New York.

1856.—**Lesley, J. P.** Manual of Coal and its Topography. Illustrated by original drawings, chiefly of facts in the geology of the Appalachian region of the United States, 224 pp., Philadelphia.

1858.—**Rogers, H. D.** Classification of the Several Types of Orographic Structure visible in the Appalachians and other undulated Mountain Chains. Geology of Pennsylvania, Vol. 2, 24 pp., Philadelphia.

1865.—**Lesley, J. P.** Appalachian Structures. Proc. American Philosophical Society, Vol. IX. 14 pp., with plates.

1878.—**Stevenson, John J.** On the Surface Geology of Southwestern Pennsylvania and adjoining Portions of Maryland and West Virginia. American Journal of Science, Vol. XV, 5 pp.

1881.—**White, I. C.** Notes on the Geology of West Virginia. Proceedings, American Philosophical Society, Vol. XIX, No. 109, pages 438-446. A rectification of the section made by Mr. Howard Grant Jones on the Cumberland or Potomac Coal Basin.

1881.—**Riordan, Owen.** The Upper Potomac Coal Field. The Virginias, Vol. III, 1 page.

1882.—**Hotchkiss, Jed.** The Mineral Resources of the Region between the Valley of Virginia and the Upper Potomac Coal Basin. The Virginias, May, 1882, 2 pp.

1884.—**White, I. C.** The Upper Potomac Coal Field in the vicinity of Fairfax Stone. The Virginias, Vol. V., 5 pp.

1890.—**White, I. C.** American Railway Guide (Geological). By James Macfarlane. Geology along Baltimore and Ohio R. R. from

Photo by E. E. HARRIS.

PLATE IV.—City of Keyser from Queens Point Looking southwestward up valley of New Creek. Stratigraphic range is from Pottsville, which makes escarpment of Allegheny Front in background and right, down to Oriskany Sandstone which forms slope of New Creek Mountain on left and a fragment of which is visible in immediate foreground.

Harpers Ferry to Wheeling, with descriptions and thicknesses of rocks, pp. 337-342.

1891.—White, I. C. Stratigraphy of the Bituminous Coal Fields of Pennsylvania, Ohio, and West Virginia. U. S. Geological Survey, Bulletin 65, 212 pp. With sections and comment along Upper Potomac.

1894.—Weeks, Joseph D. The Potomac and Roaring Creek Coal Fields in West Virginia. U. S. Geological Survey, Fourteenth Annual Report, 20 pp. With map.

1895.—Weeks, Joseph D. The Elk Garden and Upper Potomac Coal Fields of West Virginia. Trans. American Institute of Mining Engineers, Vol. XXIV, 13 pp.

1896.—Willis, Bailey. The Northern Appalachians. The Physiography of the United States, Geographic Monographs, No. 1, 169 pp., American Book Company, Cincinnati.

1896.—Darton, N. H.; and Taff, J. A. Piedmont Folio, No. 28, U. S. Geological Survey. Description of coal, iron ore, lime, stone, road-metal, and clay, with areal and structural geology and cross-sections.

1896.—Darton, N. H. Franklin Folio, No. 32, U. S. Geological Survey. Description of iron, coal, manganese, lime, stone, road-metal, and clay, with areal geology and cross-sections.

1901.—Brown, S. B. Bibliography of Works upon the Geology and Natural Resources of West Virginia from 1764 to 1901, and also a Cartography of West Virginia, from 1737 to 1901. Bulletin No. 1, W. Va. Geological Survey, 85 pp.

1903.—Ries, Heinrich. The Clays of the United States East of the Mississippi River. U. S. Geological Survey, Professional Paper, No. 11, pp. 67 and 252-261. Several references to fire clay at Piedmont.

1903.—White, I. C. Coal Report. Vol. II, West Virginia Geological Survey. General description of Coals of the State, including Mineral and Grant Counties, with sections, analyses, etc.

1904.—Lewis, Virgil A. Handbook of West Virginia. Published by West Virginia Commission of the Louisiana Purchase Exposition, 390 pp. History, natural resources, enterprises, and institutions (popular style).

1905.—Grimsley, G. P. Clays, Limestones, Cements. Vol. III, W. Va. Geological Survey, 565 pp. General study of these items in State, including Mineral and Grant Counties.

1908—White, I. C. Supplementary Coal Report, Vol. II(A), W. Va. Geological Survey, 720 pp. Further sections, analyses, and comment on coals of State, including Mineral and Grant Counties.

1909.—Grimsley, G. P. Iron Ores, Salt, Sandstones. Vol. IV, W. Va. Geological Survey, 603 pp. General descriptions of these items in State, including Mineral and Grant Counties.

1911.—White, I. C. Levels and Coal Analyses. Bulletin Two, W. Va. Geological Survey, 385 pp. Compilation of railroad and government levels, and State coal analyses to date of publication.

1911.—Brooks, A. B. Forestry and Wood Industries. Vol. V, W. Va. Geological Survey, 500 pp. Describes these items in State, including Mineral and Grant Counties.

1912.—Kindle, E. M. The Onondaga Fauna of the Allegheny Region. U. S. Geological Survey, Bulletin No. 508, pp. 38-42. Section and list of fossils at Ridgeville, Mineral County, and descriptions and plates elsewhere in volume.

1913.—**Eckel, Edwin C., and others.** Portland Cement Materials and industry in the United States. U. S. Geological Survey, Bulletin No. 522, pp. 367-371. General summary and analyses.

1913.—**Prosser, Chas. S.; Kindle, E. M.; Swartz, Chas. K.; Schuchert, Chas.; Maynard, T. Poole; and Rowe, R. B.** Upper, Middle, and Lower Devonian of Maryland. Maryland Geological Survey, 2 volumes of text and 1 volume of plates, 720, 560, and 156 pp. Complete study of Devonian with systematic paleontology, containing several sections and collections in Mineral County.

1913.—**Millspaugh, C. F.; and White, David.** Part I, Living Flora of West Virginia (Millspaugh); Part II, Fossil Flora of West Virginia (White). Vol. V(a), West Virginia Geological Survey, 491 pp. General description of these items for State, including Mineral and Grant Counties.

1913.—**Lord, N. W., and others.** Analyses of Coals in the United States with Descriptions of Mine and Field Samples Collected between July 1, 1904, and June 30, 1910. Bulletin 22, United States Bureau of Mines. Gives analyses of coals from Mineral County, pp. 280-1, and description of mines and sections, pp. 1035-1038.

1918.—**Hennen, Ray V.** Figure Showing Bituminous Coal Beds in West Virginia. W. Va. Geological Survey. Etching.

1919.—**Swartz, Chas. K.; Price, W. Armstrong; and Bassler, Harvey.** Coal Measures of Maryland. Bulletin, Geological Society of America, Vol. 30, pp. 567-596. Revision of coal column of Maryland, applicable in part to Mineral and Grant Counties.

1920.—**Ashley, Geo. H.** The Abram Creek-Stony River Coal Field, Northeastern West Virginia. U. S. Geological Survey, Bulletin No. 711F, 18 pp. Structure map, descriptions, and analyses.

1921.—**Reger, David B.** Carbon Ratios of Coals in West Virginia Oil Fields. Trans. American Institute of Mining & Metallurgical Engineers, pp. 522-526. Discussion of carbon in coal with reference to occurrence of oil and gas.

1921.—**Campbell, Marius R.** Character of Coal in the Thomas Bed near Harrison, West Virginia. U. S. Geological Survey, Bulletin No. 716H, 3 pp. 4 analyses of Oakmont Mine, Mineral County.

1923.—**Reger, David B.** Geology of Tucker County. W. Va. Geological Survey, 542 pp. With maps, including some borings and other data in the northwestern corner of Grant County.

NOMENCLATURE AND CORRELATION.

In Mineral and Grant Counties, as in many other regions, the problem of proper nomenclature and correlation of the rocks is complicated by the somewhat indiscriminate use of different systems by organizations and individuals who have published reports that deal with this territory or with other northern Appalachain areas where some of the same strata are exposed; and also by unfortunate errors of correlation introduced by early investigators whose facilities of study were much circumscribed by lack of sufficient time, funds, maps, and other essential aids, as well as by the wooded and undeveloped region in which they worked. Many of these

entirely natural and excusable mistakes, unavoidable on the part of the pioneer, have been carried through subsequent reports, however, by the blind adoption of early generalizations as established facts, and by the evident desire to make later studies correspond to, and harmonize with, previous beliefs. Another source of unfortunate multiplication of names has been the altogether too cautious attitude of scientific bureaus that adopt the easy method of introducing local names for each restricted area under study, instead of describing well-known groups of rocks by standard and widely used classifications, the resultant confusion being much more troublesome than any probable error could possibly be.

In the present Report the attempt is made to recognize and follow the earliest nomenclature of authentic publications that have had general circulation and that are of sufficient detail to be followed, and that are in accordance with the well-known tenets of the profession in using geographic names for describing geological strata, the early practice of using numbers or other arbitrary classifications of groups or individual members having long since been discarded. In the use of names for subdivisions it is also believed that many recent additions and revisions are of distinct value and recognition of them is accordingly made.

In the Pennsylvanian and Mississippian precedence is plainly due to the publications of the Geological Survey of Pennsylvania, as these volumes contain the first systematic attempt at classification in sufficient detail to be clearly recognized and followed over wide areas. In the Devonian, Silurian, and Ordovician the New York nomenclature is the clear basis of all subsequent work in the Appalachian region, the numerous revisions and additions of the Pennsylvania Survey being entitled to high respect. In the Devonian and Ordovician, also, much valuable data have been added by the Maryland Survey, but time-honored names and subdivisions of the New York and Pennsylvania organizations, in the Devonian especially, have not been properly recognized.

In Chapters VI-XV, inclusive, where the various subdivisions are discussed in detail, will be found tables of correlation in which is indicated the nomenclature of several organizations or authors, together with that adopted in this Report, and which should serve in some degree to harmonize conflicting names.

CLASSIFICATION OF OUTCROPPING ROCKS.

In Figure 5 will be found a general columnar section of the outcropping rocks of Mineral and Grant Counties, indicating the maximum and minimum thicknesses of all subdivisions of sufficient importance to be placed on the geological maps, together with a brief description of their most salient characteristics.

Figure 5.

GENERAL COLUMNAR SECTION OF ROCKS EXPOSED IN MINERAL AND GRANT COUNTIES.

(Vertical scale: 1 inch = 1000 feet).

Age	Period	Series.	Map Symbol	Section	Thickness. Feet.	Total. Feet.	Description.
Quaternary	Recent		Qal		?	?	Unconsolidated clays and gravel (river wash).
	Pleistocene		Qal		?	?	Unconsolidated clays and gravel (river terraces).
Paleozoic.	Upper Carboniferous. Pennsylvanian.	Monongahela (Part)	Cm		100 to 200	200	Gray sandstones, sandy or variegated shales, and coals, with occasional limestones.
		Conemaugh	Ccm		750 to 900	1100	Gray or brown sandstones, sandy or variegated shales, coals, occasional bands of marine shales or limestones.
		Allegheny	Ca		150 to 200	1300	Gray sandstones, sandy shales, coals, fire clays, ferruginous limestones.
		Pottsville	Cpv		350 to 500	1800	Gray sandstones, often conglomeratic, sandy shales, thin coals, and fire clays.
	Lower Carboniferous. Mississippian.	Mauch Chunk	Cmc		500 to 800	2600	Red or variegated shales, green, micaceous, and flaggy sandstones.
		Greenbrier	Cgr		100 to 300	2900	Marine limestone, occasional red shale.
		Pocono	Cpo		200 to 600	3500	Gray sandstones, often conglomeratic, sandy or reddish shales.
	Upper Devonian	Catskill	Dck		1600 to 2400	5900	Red or variegated shales, reddish-brown, gray, and green, lenticular, micaceous sandstones, often flaggy, but sometimes massive and conglomeratic.

R.C.T.

Figure 5.

GENERAL COLUMNAR SECTION
(Continued).

Age.	Period.	Series.	Map Symbol.	Section.	Thickness, Feet.	Total. Feet.	Description.
Paleozoic.	Upper Devonian (Continued).	Chemung	Dck		2500 to 3500	9400	Olive-green, fissile or pencil shales, thin, fine-grained sandstones, occasional thin conglomerates, irregular zones of highly fossiliferous marine strata, a few reddish beds near top of series.
		Portage	Dp		1700 to 2000	11400	Greenish-gray, fissile shales, greenish-gray, thin sandstones, fine-grained and very compact. No marine members noted.
		Genesee	Dg		50 to 300	11700	Black, fissile, slaty shale, occasional marine fossils.

Figure 5.

GENERAL COLUMNAR SECTION (Concluded).

Period	Series.	Map Symbol	Section.	Thickness. Feet.	Total. Feet.	Description.
Middle Devonian.	Hamilton	Dhm		300 to 1000	12700	Brown, sandy shales, with irregular cleavage, highly fossiliferous, occasional lenses of limestone nodules.
	Marcellus	Dm		500 to 800	13500	Black, carbonaceous, fissile shale, with double-bedded marine limestone in lower portion.
Lower Devonian.	Oriskany	Do		100 to 200	13700	Coarse, brown sandstone, cherty at top. Profuse marine fossils.
	Helderberg	Dhl		300 to 600	14300	Solid, marine limestone, cherty at top.
Salina Formation.	Bossardville	Sbo		200 to 400	14700	Flaggy or shaly limestone. Few marine fossils.
	Rondout	Srd		200 to 400	15100	Hard, flaggy limestone, fossils rare.
	Bloomsburg	Sbb		50 to 100	15200	Red or green shales, with persistent, hard, fine-grained green sandstone.
Silurian.	Niagara	Sna		150 to 400	15600	Shaly limestone, with profuse marine fossils. Lens of hard, green sandstone in southern Grant.
	Clinton	Scl		300 to 600	16200	Red shales, with persistent, highly fossiliferous iron ore near top. Ferruginous Iron Sandstone near base.
	White Medina	Swm		200 to 300	16500	Gray, quartzitic, massive sandstone, very hard.
	Red Medina	Srm		700 to 1100	17600	Red shales, with micaceous, flaggy or massive, reddish or greenish-gray, fine-grained sandstones.
	Gray Medina	Sgm		150 to 300	17900	Gray sandstone, with thin beds of gray shale. No fossils.
Ordovician.	Martinsburg Shale (Part)	Oms		200 to 300	18200	Dark, friable sandstone and shale. Abundant marine fossils.

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CHAPTER IV.

STRUCTURE.

METHODS OF GEOLOGIC WORK AND REPRESENTATION OF STRUCTURE.

In determining the structure, or lay, of the rocks in Mineral and Grant Counties the same method of geologic work is not applicable to the entire area. West of the Allegheny Front, where the rocks have been only slightly disturbed, and where the original strata are still approximately horizontal, and where there are numerous, well-defined and easily recognized, persistent coals, fossiliferous zones, and regularly bedded sandstones it is possible to measure thickness and determine dips over wide areas with as much exactitude and precision as circumstances may require, accuracy being limited mainly by the amount of time consumed and the instrumental methods employed.

In this region a careful structure map, showing the position of the base of the Upper Freeport ("Davis," "Split-six") Coal was made, by means of which its elevation above sea-level is shown by **red structure contours** on Maps II and IV. Inasmuch as the other coals and important horizons lie approximately parallel, the contours on this coal can be used to determine the position of any other stratum. The Upper Freeport Coal outcrops almost continuously along the North Branch of Potomac River from Piedmont southwestward nearly to Gormania and also on various affluents from the territory southward, affording direct observations, and it outcrops also along the entire western flank of the Allegheny Front where occasional prospects have been made. In addition to this coal several others occur with much persistence along the Potomac and its tributaries, from which definite intervals may be measured to the key stratum and used for observations in adjoining localities where the Upper Freeport is under drainage or concealed. Besides the coals there are definite fossiliferous zones in the Conemaugh Series, above

the Upper Freeport, and heavy, bedded sandstones in the Pottsville Series, below it, that are of further advantage to the stratigrapher.

In the region farther southwest, where the Upper Freeport lies below drainage over wide areas, many core tests have been bored to test its depth and thickness as well as to determine the presence of other coals. Through the courtesy of the operators the writer has had the use of the records of nearly all these tests, besides having the accurate spirit-levels by which the surface elevations of many of them were determined.

Through the use of the hand-level, or the aneroid, closely checked on accurate Government levels, it is believed that the resulting structure map will be found accurate for general mining purposes.

In the region east of the Allegheny Front, where orogenic disturbance has been comparatively severe, entirely different methods of stratigraphic work were required. In this portion of the two counties the rocks have been greatly tilted, being vertical in some localities and elsewhere overturned, faulted, or duplicated. Under such conditions the aneroid or level becomes of small value, the combination clinometer and pocket transit by which dips and directions may be determined taking their place. By the use of the topographic maps, on which localities may readily be plotted at a glance, it was possible to make a great number of cross-sections across the dips, and to record accurately the contact lines of the different series. Several of these cross-sections have been plotted to scale and appear on the margins of Maps II and IV. In various localities also, where conditions were favorable, horizontal measurements were made across the dips to secure data for the computation of thicknesses by trigonometric methods, and the resulting sections appear in Chapter V under the subject of "Measured Sections."

DETAILED STRUCTURE.

GENERAL FEATURES.

As mentioned above, the region west of the Allegheny Front is an area of gentle, symmetrical folds, of comparatively slight disturbance, and as a whole may be considered as one broad basin in which minor structural relief has developed, being bordered on the northwest by a region of great uplift through Randolph, Tucker, and Preston Counties, West Virginia, and Garrett and Allegany Counties, Maryland, and on the southeast by another region of much more violent upheaval

through southeastern Grant and Mineral Counties. In this wide basin the rocks have remained nearly horizontal through the agency of competent strata, capable of resisting in large measure the force of lateral thrust, there being many heavy sandstones of great compressive strength in the 1,800 feet of Pennsylvanian measures which cover the surface, as well as in the Greenbrier, Pocono, and Catskill beneath them. It is probable that severe folding may have occurred in the softer rocks of the Devonian and other shaly series down below the competent rocks, but if this be the case such upheavals are completely bridged over by the younger measures.

In the region east of the Allegheny Front the Pennsylvanian, Mauch Chunk, Greenbrier, Pocono, and Catskill Series have been entirely eroded, leaving the largely incompetent strata of the Devonian and lower measures in which lateral thrust has produced severe folding. Whether the competent strata formerly bridged this area with gentle surface folds is a question on which no definite conclusion may be reached, although it is probable that they were broken by more severe thrusts than prevailed in the region westward and were in consequence rapidly eroded during and soon after the cycles of uplift.

ANTICLINES AND SYNCLINES WEST OF ALLEGHENY FRONT.

In the region west of Allegheny Front there are two synclines in the southern territory, which converge into one basin farther northeast, and one anticline in the southern area, which dies out at the junction of the two basins. In regular order from west to east these folds are as follows:

North Potomac (Georges Creek) Syncline.
Blackwater Anticline
Stony River Syncline.

North Potomac (Georges Creek) Syncline.—The North Potomac Syncline of Darton and Taff,[1] or Georges Creek Syncline of O'Harra,[2] is the principal basin that affects the Carboniferous strata of the western portions of Mineral and Grant Counties. The same syncline has been designated by various titles in Pennsylvania,[3] but these earlier names, al-

[1]N. H. Darton and J. A. Taff, Piedmont Folio, No. 28, United States Geological Survey; 1896.

[2]C. C. O'Harra, Allegany County Report, Maryland Geological Survey, pp. 150-152; 1900.

[3]The name "Buckstown" was applied to it by the First Geological Survey of Pennsylvania, but it was later (Report T2, Second Geological Survey of Pennsylvania; 1882) termed the "Savage Mountain Syn-

though entitled to precedence by strict interpretation of the rules of geological nomenclature, appear to have fallen entirely into disuse and would be confusing if now revived. It is therefore thought best in the present volume to use only the names "North Potomac" and "Georges Creek," both of which are commonly applied to the basin, the former being the earlier and more preferable title, the same designation having been used in the Report of the writer for the Survey on Tucker County.

This syncline, the location of which north of the Maryland-Pennsylvania Line is not pertinent to this Report, enters the former State about 2½ miles northeast of Mount Savage and extends down the Georges Creek Valley, passing just east of Mount Savage, about one mile east of Frostburg, through Lonaconing, one-half mile east of Barton, and thence veering slightly farther westward, cuts a bend of the North Branch of Potomac River at the mouth of Savage River and enters Mineral County, West Virginia, 0.3 mile east of Hampshire. From Hampshire its course is southwestward four miles to a point one mile south of Barnum where it divides into two basins, the principal of which (North Potomac or Georges Creek) extends nearly westward across the Potomac 0.6 mile north of Shaw, and thence with a general southwesterly direction crosses Threeforks Run midway between Vindex and Chaffee, goes approximately through Tasker Corners and Kearney, and continuing southwestward, lies about one mile northwest of Gormania, the same distance northwest of Bayard, 0.7 mile northwest of Wilson, 0.6 mile northwest of Dobbin, and passing through the eastern edge of Kempton crosses the Potomac again, and turning slightly more southward crosses the line between Garrett County, Maryland, and Grant County, West Virginia, one-fourth mile northeast of Fairfax Stone. From this point it extends through Grant for one-third mile and passes into Tucker County. In Tucker it passes through or near Thomas, Douglas, and the mouth of Otter Creek, and reaching the Randolph County Line near the point where Otter Creek crosses the same, it goes on to Shavers Fork of Cheat River a short distance east of Bowden Station, and thence southwestward up Shavers Fork to the source of that stream in Pocahontas County.

Along that portion of its length between Savage River and Fairfax Stone this basin is fairly symmetrical, the rise

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clinal" by Jno. J. Stevenson. Still later (on map made to accompany Report HHH, Second Geological Survey of Pennsylvania; 1888) it was styled the "Wellersburg Basin" by John Fulton.

in either direction from the axis being comparatively gentle but becoming more rapid at a greater distance. The surface geology is predominantly that of the Conemaugh Series, the full thickness of which is exposed at the mouth of Savage River, with remnants of the Monongahela in the tops of the hills and with a considerable portion of the Allegheny visible along the river. At the junction of the two basins between Barnum and Shaw the Monongahela is eroded but is found in higher summits farther southeast. Along the axis in Garrett County, Maryland, southwest of Shaw, the Monongahela does not appear again except in the vicinity of Fairfax Knob.

In general there is a southwestward rise of the strata along the basin. At Savage River the Upper Freeport Coal is about 1,085 feet above sea-level and at the junction south of Barnum it is 1,185 feet. From this point the rise is rapid to Lostland Run where it is almost 2,000 feet. For several miles farther there is little change but about one mile northeast of Kempton the normal rise again begins, the elevation at Fairfax Knob being about 2,350 feet.

From an economic standpoint the presence of this syncline along or near the western borders of Mineral and Grant Counties is of vast importance, as it has preserved from erosion many valuable coal beds in which there is an extensive mining industry.

Blackwater Anticline.—The Blackwater Anticline of Darton and Taff[4] occurs between the North Potomac (Georges Creek) and Stony River Synclines, its origin being in the vicinity of Chaffee, Mineral County. From Chaffee it extends southwestward for several miles, mostly through Maryland, passing one-third mile west of Schell and directly through Wallman and thence with the Potomac River to the mouth of Difficult Creek and continuing in the same direction to a point one mile southeast of Gormania, where it turns almost directly southward and so continues to the Grant-Tucker County Line 3½ miles northeast of Gatzmer. In Tucker County it goes southwestward through the Canaan Valley and crosses into Randolph County near Jenningston, beyond which its course is of no present interest.

At its northern end, where this anticline makes a nose at the junction of the two basins, it is lacking in symmetry, the dips being apparently steeper on the west toward the North Potomac (Georges Creek) Syncline than on the east toward the Stony River Basin and its position relative to the two depressions being much nearer to the former than to the

[4]N. H. Darton and J. A. Taff, Piedmont Folio, No. 28, United States Geological Survey; 1896.

latter. Between the main turn in its course one mile southeast of Gormania and the Tucker County Line, it becomes symmetrical and approximately equidistant from the two basins, but south of the Tucker Line the steeper dips are found on the east side and the crest of the arch is much nearer to the Stony River than to the North Potomac (Georges Creek) Syncline.

In general there is a rapid southerly rise along the axis, but from Hubbard to the turn near Gormania there is a comparatively flat sector in which the total rise is only 300 feet in 7 miles, or at the rate of 43 feet per mile, there being a shallow saddle in the vicinity of Wallman and a low, closed dome one mile north of this point. From the turn southward to the Tucker County Line there is a rise of 750 feet in 5 miles, making a rate of 150 feet per mile, and from this point southward to the summit of the great dome 2½ miles northeast of Cortland there is a rise of 1,750 feet in 10 miles, with a rate of 175 feet per mile. Beyond the dome there is a substantial fall toward Jenningston.

In Mineral, Garrett, and Grant Counties the surface geology is that of the Conemaugh, Allegheny, and Pottsville Series. At Chaffee the Upper Freeport Coal has an elevation of 1,640 feet, at Hubbard 2,200 feet, and at Wallman 2,400 feet, a portion of the Pottsville being exposed along the Potomac gorge between the latter two points. Southward from the mouth of Difficult Creek, where the arch leaves the Potomac, the Pottsville goes under drainage in the rising topography but appears again near the Tucker County Line. At the dome in the Canaan Valley northeast of Cortland the entire Pennsylvanian is eroded, leaving the Pocono Sandstone of the Mississippian as the surface outcrop.

The topography along the arch in Mineral, Garrett, and Grant Counties is rough and boulder strewn, except on some of the uplands where the soft shales of the Conemaugh are found. In the Canaan Valley of Tucker County a combination of circumstances, previously discussed by the writer in the Report on that area, gives rise to a wide, marshy condition.

The Blackwater Anticline has been described in a recent publication by Ashley,[5] under the name of the "Canaan Valley Anticline," but as the work of Darton and Taff antedates that of Ashley by 24 years the title adopted by them deserves precedence.

Stony River Syncline.—The Stony River Syncline of Dar-

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[5]Geo. H. Ashley, Bull. 711-F, United States Geological Survey, p. 98; 1920.

ton and Taff[6] is an important feature of the coal rocks of western Mineral and Grant Counties. Branching from the North Potomac (Georges Creek) Syncline one mile northeast of Shaw, Mineral County, it extends southwestward through Shaw, the eastern edge of Elk Garden and Emoryville, and passing just west of Wabash enters Grant County one mile beyond. In Grant it passes through the mouth of Johnnycake Run of Abram Creek and crosses Stony River one mile northwest of Mount Storm. Just west of the bridge of the Northwestern Pike across the river it turns abruptly southeastward and again crosses the river one mile south of the bridge, only two miles of its length being on the west side in this locality. From the river its course continues southeastward for only two miles to a point three-fourths mile northwest of Bismarck, where it turns southwestward again and so continues to the Tucker County Line, passing just east of the mouth of Helmick Run of Stony River and skirting the eastern shore of Stony River Dam. It enters Tucker County near the head of Stony River two miles west of the Bear Rocks and thence continues with an irregular but generally southwestern course to the Randolph County Line two miles east of Laneville, beyond which it has not been studied in detail, its crossing of Seneca Creek near Onego, Pendleton County, however, being a well-established fact.

Throughout most of its course in Mineral and Grant Counties this syncline is fairly symmetrical about its axis but in the vicinity of the Northwestern Pike between Stony River and Difficult Creek the comparatively flat structural surface that is usually found only near the axis widens toward the west, corresponding to the opposite bend in the Blackwater Anticline.

Along the axis of the basin there is a rapid and fairly uniform southwestward rise of the strata, the elevation of the Upper Freeport Coal at the junction north of Shaw being 1,185 feet, at the Mineral-Grant County Line 1,900 feet, and at the Grant-Tucker Line 3,400 feet, the total distance from the junction to the Tucker Line being approximately 29 miles and the total rise being 2,215 feet, making an average of 76 feet per mile.

In Mineral County the surface geology is that of the Monongahela and Conemaugh Series, there being Pittsburgh Coal in several of the high ridges. In Grant County the Monongahela is entirely eroded from the tops and the Conemaugh only is the principal exposure directly along the axis, but the

[6]N. H. Darton and J. A. Taff, Piedmont Folio, No. 28, United States Geological Survey; 1896.

Allegheny soon appears at the surface at short distances east and west.

In Mineral and northern Grant the topography is mainly rough in the valleys but smooth on the ridges but along Stony River southwest of Bismarck the land is exceedingly rough and strewn with boulders, and almost totally uninhabited.

STRUCTURE CONTOURS ON UPPER FREEPORT, "SPLIT-SIX," "DAVIS" COAL.

In the coal-bearing region of western Mineral and western Grant the **Upper Freeport, "Split-six," "Davis" Coal** has been used as the basis of the structure map. This coal outcrops extensively and has been mined at numerous points along the Potomac and some of its tributaries and also outcrops along the western base of the Allegheny Front. In other regions where it is under drainage there have been numerous holes drilled to its horizon, so that it is exceptionally well suited for a key rock. On Maps II and IV, which accompany this Report, the elevation of its base has been indicated by **Red Contour Lines.** These contours extend from the summit of the Allegheny Front, where the Coal Measures (Pennsylvanian) disappear on the southeastward rise, westward to the limits of Mineral and Grant Counties, and are also shown in adjoining portions of Tucker County and Garrett County, Maryland, where their inclusion adds valuable information owing to the intimate relationship of these counties with Mineral and Grant.

The detailed work necessary to prepare the structure map included many hundreds of observations on the key rock and other known stratigraphic horizons. Elevations were obtained mainly by the use of the aneroid checked on the nearest Government spirit-level determination as recorded on the topographic maps. In many cases it was possible to make hand-level measurements directly to the mines and prospects, thus reducing the possible error. Spirit-level determinations made by the Davis Coal and Coke Company on many of their borings and prospects were also placed at the disposal of the Survey, adding greatly to the accuracy of the work. Experience in other counties has proved that levels obtained by the aneroid and checked on the topographic base maps are seldom as much as 25 feet in error, being often within 5 to 10 feet of the truth, and it is believed that the structure maps of Mineral and Grant will generally come within these limits.

There is a considerable variation in interval between the various stratigraphic horizons at different points, due mainly

Intervals Above Upper Freeport, "Split-Six," "Davis" Coal—Mineral and Grant Counties, Region West of Allegheny Front.

Member	Bismarck	Elk Garden	Fairfax	Gormania	Hartmansville	Henry	Laneville	Mt. Storm	Oakmont	Piedmont	Schell	Shaw	Stony River Dam
Sewickley Coal		900								895		(900)	
Redstone Coal		830	(870)							840		(830)	
Pittsburgh Coal		775	850		(775)				(775)	800		775	
Morantown Coal		730	835		(750)				(750)	780		(755)	
Little Pittsburgh Coal		700	775									(735)	
Second Little Pittsburgh Coal		660										(690)	
Third Little Pittsburgh Coal													
Franklin "Rider" Coal		650										660	
Little Clarksburg, "Franklin" Coal		640	730	(650)	(650)	(625)			(650)	640		650	
Normantown, "Upper Hoffman" Coal												575	
Middle Hoffman Coal													
Upper Clarysville Coal								590					
Lower Clarysville Coal		560						560					
Wellersburg "Rider" Coal												505	
Wellersburg Coal												490	
Barton "Rider" Coal								455	(455)			(465)	
Elk Lick, "Barton," "Four-Foot" Coal	(450)	460	440	450	425	(430)		425	425	440	430	450	
West Milford Coal													
Federal Hill Coal				(390)	(365)				(365)	370	(365)	410	
Duquesne Coal												400	
Ames Shale	342	342	327		311	327		311	316	341	316	326	(331)
Harlem Coal	340	340	325	335	310	325		310	315	340	315	325	(330)
Upper Bakerstown Coal		240		240	(215)	(230)		220	205	230	205	230	(225)
Bakerstown, "Thomas," Coal	200	200	200	215	190	205	175	195	180	180	185	200	195
Pine Creek Limestone	(185)	175	(175)	(190)	(170)	(185)	(155)		(160)	165	(170)	190	(175)
Brush Creek Shale	116	121	126	126	101	131	101	106	101	121	101	136	136
Brush Creek Coal	(115)	120	125	125	100	130	100	105	100	120	100	135	135
Mahoning "Six-foot" Coal	(50)	40	75	50	40	50	70	45	45	40	40	35	50
UPPER FREEPORT, "SPLIT-SIX," "DAVIS" COAL	0	0	0	0	0	0	0	0	0	0	0	0	0

Intervals Below Upper Freeport, "Split-Six," "Davis" Coal—Mineral and Grant Counties, Region West of Allegheny Front.

Member	Bismarck	Elk Garden	Fairfax	Gormania	Hartmansville	Henry	Laneville	Mt. Storm	Oakmont	Piedmont	Schell	Shaw	Stony River Dam
UPPER FREEPORT, "SPLIT-SIX," "DAVIS" COAL	0	0	0	0	0	0	0	0	0	0	0	0	0
Lower Freeport Coal	25	.....	(30)	35	.....	40	25	(40)	(40)	35	40	.....	(30)
Upper Kittanning Coal	70	70	70	85	.....	(90)	95	(75)	75	100	130	.....	60
Middle Kittanning Coal	(90)	.....	(110)	(120)	.....	120	.....	(110)	(110)	.....	(170)	.....	115
Lower Kittanning Coal	(120)	150	130	(140)	.....	135	.....	(130)	130	150	200	.....	135
Clarion Coal	(150)	.....	160	(150)	.....	.....	.....	(160)	(160)	(160)	(205)	.....	145
Homewood Sandstone (Top)	170	(200)	170	160	.....	140	105	(165)	165	165	210	.....	155
Tionesta Coal	.....	.....	.....	(230)	.....	205	.....	.....	.....	245	285	.....	.....
Upper Mercer Coal	.....	.....	.....	(245)	.....	230	190	.....	.....	260	.....	.....	.....
Lower Mercer Coal	.....	.....	.....	(260)	.....	240	235	.....	.....	275	.....	.....	.....
Quakertown Black Shale	.....	.....	.....	(338)	.....	.....	310	.....	.....	448	.....	.....	.....
Quakertown Coal	.....	.....	.....	(340)	.....	(345)	315	.....	.....	450	.....	.....	.....
Hartridge Shale	.....	.....	.....	515	.....	.....	465	.....	.....	499	.....	.....	.....
Sewell ("Sharon"?) Coal	.....	.....	.....	520	.....	.....	470	.....	.....	500	.....	.....	(550)
Fire Creek Coal	.....	.....	.....	(625)	.....	.....	580	.....	.....	540	.....	.....	.....
Pottsville Series (Base)	(600)	.....	.....	645	.....	.....	600	.....	.....	550	.....	.....	600
Greenbrier Limestone (Top)	.....	.....	.....	1150	.....	.....	1400	.....	.....	1100	.....	.....	.....

to local unconformity and partly to regional thickening of the measures. In order that this fact might not interfere with the accuracy of the structure map, or destroy its purpose, numerous detailed stratigraphic cross-sections and special measurements of intervals from place to place were made.

The principal results of these many observations are condensed in the preceding tables, showing intervals above and below the base of the Upper Freeport, "Split-six," "Davis" Coal, the table having been used in determining contours on the coal in localities where direct observations could not be obtained. Its use in conjunction with the additional data presented in Chapter V is recommended for those who prospect further for the coals or other economic strata. Several columns in the table show vacant spaces either because the members named at the left belong above the tops of the ridges or because they lie below drainage and there are no present data to show the information called for. Figures in parentheses indicate that the member was not found in the locality called for at the top of the column, or its horizon was above the topography or below drainage, sufficient general information being available to approximate its interval fairly well by deduction. In order to find the approximate elevation of any coal its interval from the Upper Freeport bed should first be obtained by using the table or by referring to the local section measured for the nearest point. Having the structure contours as a guide the coal should then be easily found.

ANTICLINES AND SYNCLINES EAST OF ALLEGHENY FRONT.

In the region east of the Allegheny Front there are numerous anticlines and synclines, all lying approximately parallel to the principal mountains, but none, with the exception of the Wills Mountain Anticline, extending entirely across the two counties. Several of the principal arches and depressions, however, are of considerable length, constituting the main orogenic features, while many others are of only minor extent and importance. Along the major folds steep dips are the usual rule, vertical or overturned strata being not infrequent, and faults or duplications being occasionally found. In accordance with the early generalization of the Rogers Brothers, extremely steep dips are much more frequent on the western flanks of the anticlines, the eastern slopes being often fairly gentle. Many of the larger anticlines are nearly coincident with the main mountain ridges but there are enough important exceptions to preclude the use of such a statement as a general rule for the territory under discussion.

In order to afford a summarized view of the numerous anticlines and synclines of the two counties they will be listed in regular order along several parallel lines, starting in each case at or near the eastern boundaries of the two counties and passing northwestward or westward toward the Allegheny Front, mainly at right angles to the line of strike, as no single cross-section would include them all. By this plan their occurrence is as follows:

Anticlines and Synclines along extreme northern end of Mineral County northwestward from Hampshire County Line to Cumberland.

Big Springs Run Syncline.
Martin Mountain Anticline.
Martin Spring Branch Syncline.
Tussey Mountain Anticline.
Bean Cove Syncline.
Evitts Mountain Anticline
Bedford Syncline.
Wills Mountain Anticline

Anticlines and Synclines northwestward across Mineral County along line between Frankfort and Cabin Run Districts.

Big Springs Run Syncline (in edge of Hampshire County.)
Tussey Mountain Anticline.
Bean Cove Syncline.
Evitts Mountain Anticline.
Bedford Syncline.
Wills Mountain Anticline.
Rawlings Syncline.
Noswad Anticline.
Noswad Syncline (Allegany County, Maryland.)
Fort Hill Anticline (Allegany County, Maryland).

Anticlines and Synclines northwestward across eastern Mineral County along line between Cabin Run and Welton Districts, east of Allegheny Front

Big Springs Run Syncline (in edge of Hampshire County).
Beaver Run Anticline.
Russelldale Syncline.
Tussey Mountain Anticline.
Bean Cove Syncline.
Evitts Mountain Anticline.
Bedford Syncline.
Wills Mountain Anticline.

Anticlines and Synclines northwestward along Mineral-Grant County Line, east of Allegheny Front.

Elliber Syncline.
Patterson Creek Mountain Anticline.
Bean Cove Syncline.
Evitts Mountain Anticline.
Bedford Syncline.
Wills Mountain Anticline.
Laurel Dale Syncline.
Laurel Dale Anticline.

Anticlines and Synclines along line slightly north of west through Medley and Greenland Gap, Grant County, east of Allegheny Front.

Patterson Creek Mountain Anticline.
A Minor Syncline (not named).
A Minor Anticline (not named).
Bedford Syncline.
Wills Mountain Anticline.
A Minor Syncline (not named).
A Minor Anticline (not named).

Anticlines and Synclines from Durgon, Hardy County, slightly north of west toward Jordan Run Post-office, Grant County, east of Allegheny Front.

Middle Mountain Syncline (in Hardy County.)
Welton Anticline.
Kessel Syncline.
Kessel Anticline.
Hiser Syncline.
Patterson Creek Mountain Anticline.
A Minor Syncline (not named).
Cave Mountain Anticline.
Bedford Syncline.
Royal Glen Anticline.
Blue Rock Syncline.
Wills Mountain Anticline.

Anticlines and Synclines from Elkhorn Rock northwestward through North Fork Gap, Grant County, east of Allegheny Front.

Elkhorn Mountain Anticline.
Middle Mountain Syncline.
Welton Anticline.
Hiser Syncline.
Cave Mountain Anticline.
Sawmill Syncline.
Sawmill Anticline.
Bedford Syncline.
Royal Glen Anticline.
Blue Rock Syncline.
Peacock Cave Anticline.
Corners Syncline.
Wills Mountain Anticline.
Hopeville Syncline.
Hopeville Anticline.

Anticlines and Synclines northwestward along Grant-Pendleton County Line, east of Allegheny Front.

Deep Spring Syncline.
Elkhorn Mountain Anticline.
Middle Mountain Syncline.
Cave Mountain Anticline.
Blue Rock Syncline.
Wills Mountain Anticline.
Hopeville Syncline.
Hopeville Anticline

Inspection of the above lists reveals that several of the folds have a linear extent of only a few miles while others are many miles long, and one, the Wills Mountain Anticline, is present entirely across the two counties. The detailed descriptions of these structural wrinkles will be taken up approximately in the order named, each one being traced southwestward to its terminus or to the Pendleton County Line if it reaches into that territory. The positions of all of them are

indicated on Maps II and IV, which accompany this Report. An inspection of the topographic features in connection with structural lines shows the interesting fact that some of the larger mountains, which are along approximate lines of strike and would appear to represent continuous folding separated by low saddles, are in reality entirely disconnected regions of uplift, although of probable contemporaneous origin.

The crumpling of the earth's surface which produced anticlines and synclines in Mineral and Grant Counties has naturally extended into adjoining territory northward and southward. On the north, in Blair County, Pennsylvania, they were studied and described in detail by Franklin Platt, as published in Report "T" of the Second Geological Survey of that State in 1881. In Bedford and Fulton Counties, lying south and southeast of Blair County, in the same State, they were described by John J. Stevenson in Report "T 2" of the same Survey, published in 1881. In Allegany County, Maryland, lying south of Bedford and Fulton, and directly north of Mineral, they were described by C. C. O'Harra in the Report on Allegany County published by the Maryland Geological Survey in 1900. South of Grant County, and including a portion of its southern territory, they were described by N. H. Darton in the Franklin Folio, No. 32, published by the United States Geological Survey in 1896.

The historical succession of these various Reports indicates that the nomenclature of Platt is entitled to precedence, followed in turn by that of Stevenson, Darton, and O'Harra. In attempting to follow the structural descriptions of all these writers, however, many difficulties occur to prevent giving the full recognition that these earlier Reports deserve. In Blair County the structure is referenced in part to place names that do not appear on the map and largely to the residences of individuals, the locations of which are entirely unknown, and the axes of the anticlines and synclines are not delineated on the areal geology map, so that any attempt to carry the highly complex structure southward at this late date would introduce many serious errors. In Bedford County little attempt appears to have been made to bring southward the names employed by Platt. In this report (T 2) the anticlines are delineated on the areal geology map but the names used do not appear with them, and few of the mountains and other place names by which they are described in the text are on the map. In Allegany County there is a good areal map and the structures are described in the text, but their axes are not delineated on the map. In this Report, also, the names of Stevenson, several of which could have been used, are given only scant

recognition, new titles often being employed for folds which may be clearly traced across the Pennsylvania-Maryland border.

Another difficulty in tracing the folds southward from these counties by their early nomenclature lies in the fact that several of the large anticlines bifurcate two or three times and in some cases the branches are described without clearly defining the main, continuous arch.

In the Franklin Folio the anticlines and synclines are described briefly in the text but their axes are not indicated on the areal geology map except by a few cross-sections, and in one instance there appears to have been a somewhat serious misinterpretation of the structure.

Subject to the limitations expressed above, the writer now attempts to bring into Mineral and Grant Counties as much of the earlier nomenclature as may be prudently used, that of Platt being rejected because of its uncertain relationship and that of Stevenson being recognized when possible, followed in turn those of Darton and O'Harra.

Big Springs Run Syncline.—The Big Springs Run Syncline of O'Harra[7] appears to have its beginning between two branches of the Tussey Mountain Anticline near the head of Big Springs Run, Allegany County, about 6 miles northward from Round Bottom. Passing southwestward and becoming wider it crosses North Branch of Potomac River and enters Mineral County just west of Round Bottom, from which point it extends southwestward and southward until it reaches the Hampshire County Line near the head of Broad Hollow about three miles from the Potomac. In Hampshire it extends southwestward, crossing the Frankfort-Springfield road one-fourth mile east of the summit of Middle Ridge, and continuing with the same general direction to Mill Creek of South Branch, 0.8 mile east of Junction, beyond which its position is unknown. Throughout its course from the road mentioned the location of its axis varies from one-half to one mile east of the summit of Middle Ridge, erosion having apparently been more rapid on the eastern than on the western side of the ridge.

Throughout its course in Mineral County this syncline is of fair symmetry. Along the North Branch the Portage Series of the Upper Devonian outcrops, but farther south toward the Hampshire Line the basal Chemung is present on the ridges. Minor reversals of dip are common, owing to the incompetent nature of these strata.

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[7]C. C. O'Harra, Allegany County Report, Maryland Geological Survey, p. 144; 1900.

Martin Mountain Anticline.—The Martin Mountain Anticline of O'Harra,[8] which is described as one of the principal bifurcations of the Tussey Mountain Anticline of Pennsylvania, appears to have its beginning about one mile northeast of Twiggtown, Allegany County, where it branches from the Tussey Mountain arch, and thence follows the line of Martin Mountain southwestward to North Branch of Potomac which it crosses one mile southeast of Patterson Creek Station. In Mineral County it continues southwestward for three miles, being marked by a low but well-defined topographic ridge, and dies out on a branch of Patterson Creek two miles northeast of Frankfort. Its extent in this county is featured by an outcrop of the Oriskany Sandstone, which in conformity with the Appalachian law of Rogers dips more steeply on the western than on the eastern flank of the fold.

Martin Spring Branch Syncline.—The Martin Spring Branch Syncline of O'Harra[9] apparently has its beginning at one of the bifurcations of the Tussey Mountain Anticline just west of Twiggtown, Allegany County, and passing southwestward approximately coincident with the narrow valley of the branch from which it is named crosses North Branch and enters Mineral County 0.7 mile east of Patterson Creek Station. From this point it extends southwestward through a well-marked, but extremely narrow topographic valley to a branch of Patterson Creek about two miles northeast of Frankfort and dies out opposite the southern end of the Martin Mountain Anticline. The surface outcrop along its length in the county is that of the Marcellus Shale of the Devonian.

Tussey Mountain Anticline.—The Tussey Mountain Anticline of Stevenson,[10] described as having its beginning as a separate fold in Southampton Township, Bedford County, where a bifurcation occurs in what is known northward as the Evitts-Tussey Anticline, appears to extend southwestward across Allegany County, passing just west of Twiggtown and thence following the line of Collier Mountain to the North Branch which it crosses one-fourth mile east of Patterson Creek Station. It is described by O'Harra as the "Collier Mountain Anticline," being one of the three prongs of the main Tussey Mountain fold of Pennsylvania. Inasmuch as the most eastern of these three branches apparently dies out before reaching the West Virginia Line and the middle,

[8]Ibid., p. 144.

[9]Ibid., p. 144.

[10]John J. Stevenson, Report T 2, Second Geological Survey of Pennsylvania, p. 23; 1881.

or Martin Mountain Anticline, is an arch of small uplift where it crosses the Potomac, while the western or Collier Mountain fold is a bold feature at the river and extends for many miles southwestward, the writer believes that this latter may safely be considered as the main extension of the Tussey Mountain uplift and that its name should be preserved.

From the Potomac southwestward the Tussey Mountain Anticline follows the line of Patterson Creek Ridge four miles to the southern end of that topographic feature, one mile northeast of Frankfort, and thence passing by way of Frankfort southwestward through the valley of Patterson Creek, the meanders of which it crosses several times, leaves the valley at Reeses Mill and continuing southwestward on the west side of the creek crosses Staggs Run 1½ miles west of Headsville and may be definitely traced to a point one-half mile north of Burlington, Mineral County. From the southern end of Patterson Creek Ridge its position has no topographic expression but the dips on either flank are clearly visible and stratigraphic and paleontologic evidence confirm its presence at most points along its course.

From Burlington southward its further extension is not certain. If present it must turn almost directly southward in conformity with the eastward warping of the axes of parallel folds, the positions of which are plain. Such a direction would take it obliquely across the wide valley of Patterson Creek where outcrops and dips are almost totally obscured for two or three miles and would necessarily connect it with the northern end of the Patterson Creek Mountain Anticline. It seems quite probable that such a connection may exist and it is questionably indicated on Map II, but in the absence of direct proof it seems better to describe the latter as a separate fold.

Through that portion of its course that includes the length of Patterson Creek Ridge, the Tussey Mountain Anticline is a narrow, symmetrical fold, there being steep dips on either flank. The surface geology at the Potomac River is that of the Helderberg Limestone of the Lower Devonian, which makes a prominent outcrop in the end of the ridge, covered in turn by the Oriskany Sandstone. Southward from the immediate vicinity of the river the Oriskany covers the ridge for about one mile, beyond which there is an exposure of Helderberg for about two miles along the high point of the arch, followed by a further covering of Oriskany for another mile near the southern end of the ridge. From the end of the ridge southward for 3½ miles the Marcellus Shale is the surface outcrop, but this goes under drainage near the

mouth of Kellar Run and the Hamilton Shale, which succeeds it, is exposed for nearly five miles to a point one-half mile south of Reeses Mill. From this locality southward there is an extremely narrow outcrop of Genesee Shale, which is well exposed where the arch crosses Staggs Run and contains typical fossils at that point. Just south of Staggs Run the measures rise again quite perceptibly and the Hamilton again makes the surface to the possible southern termination of the fold near Burlington.

Along that portion of the anticline between the southern end of Patterson Creek Ridge and Burlington it appears to be asymmetrical, as the distance eastward to the Big Springs Run Syncline is four miles while that to the Bean Cove Syncline on the west is seldom as much as one-half mile. The latter is a shallow basin, however, while the former is deep, and the discrepancy in distances by no means represents a corresponding difference in dip. Throughout all this region there is much variation in local dips, due to the incompetent nature of the shales, so that individual observations give little idea of the probable averages.

The outcrops of the Hamilton and Marcellus Shales along this anticline, as well as on other structural features, are responsible for the high fertility and easily tillable quality of the soils of the Patterson Creek Valley.

Bean Cove Syncline.—The Bean Cove Syncline of Stevenson,[11] which was described by O'Harra as the "Collier Run Syncline" in the Report on Allegany County, apparently originates a few miles north of Beans Cove, Bedford County, where the Tussey and Evitts Mountain Anticlines separate from each other in passing southward. It crosses the Pennsylvania-Maryland Line 3½ miles northwest of Flintstone, follows the northern end of Martin Mountain for a few miles and then extends southwestward with the valley of Collier Run until it reaches West Virginia near the mouth of that stream just west of Patterson Creek Station. From the Potomac southwestward it closely follows the valley of Patterson Creek for nearly twelve miles, passing about one-third mile west of Frankfort, and lying just west of Reeses Mill. From this point southwestward its axis is always west of the creek. It crosses Staggs Run 1.8 miles west of Headsville, Mill Creek one-half mile west of Burlington, Wild Meadow and Mikes Runs one mile west of their mouths, and the Grant County Line one-half mile west of the creek. Southwestward in the latter county it extends only five miles, dying

[11]Ibid., pp. 24-25.

out on North Fork of Patterson Creek one mile northwest of Medley.

Throughout its length in Frankfort and Cabin Run Districts it is an extremely narrow basin, being seldom as much as one-half mile distant from the anticlines on either side. Southwest of Burlington it preserves the same relationship to the Evitts Mountain Anticline on the west but is distant 1½ to 2 miles from the great Patterson Creek Mountain Anticline on the east, the intermediate slope being broken by minor folds.

For the first three miles of its length southwest of the Potomac the surface outcrop is that of the Marcellus Shale, followed by the Hamilton which continues to a point about one-half mile southwest of Reeses Mill, where a narrow belt of Genesee, scarcely more than one-eighth mile in length, crosses its axis, after which the outcrop is Portage Shale to its southern termination, this latter region being marked by the extremely thin soil that is characteristic of the Portage.

Evitts Mountain Anticline.—The Evitts Mountain Anticline of Stevenson,[12] lying west of the Bean Cove Syncline, was originally described as the "Evitts-Tussey Anticlinal" from the fact that the two arches join into one large fold a few miles north of Beans Cove, Bedford County. Being entirely distinct uplifts in both Maryland and West Virginia the original name can not be preserved without obvious confusion, and it has been described as a separate feature by O'Harra in his Allegany County Report.

Entering Maryland along the backbone of Evitts Mountain this anticline extends southwestward across Allegany County, being coincident with the southern end of Nicholas Mountain, and enters West Virginia 0.7 mile northwest of Patterson Creek Station. South of the Potomac it crosses Plum Run one-third mile west of Patterson Creek, Tanners Run 0.8 mile west of the creek, passes 0.9 mile west of Frankfort, crosses Cabin Run 0.6 mile west of the creek, passes one-half mile west of Reeses Mill, crosses Staggs Run 2.1 miles west of Headsville, and Mill Creek 1.2 miles west of Burlington. South of Burlington it crosses Mikes Run 1.2 miles west of the creek, Thorn Run 1.5 miles northwest of Williamsport and dies out on North Fork of Patterson Creek, slightly more than one mile northwest of Medley, opposite the end of the Bean Cove Syncline.

Throughout most of its length in West Virginia this anticline is a narrow fold of apparently symmetrical appear-

[12]Ibid., pp. 23-24.

ance, its distance from the narrow Bean Cove Syncline on the east being much less than from the comparatively deep Bedford Basin on the west. At the Potomac River the upper portion of the Helderberg Limestone is exposed, but this goes under the river bluff and does not appear again, the Oriskany Sandstone making the surface outcrop southward nearly to Plum Run. After a short exposure of Marcellus and Genesee the Portage is present at the surface for a distance of nearly four miles in the region just northwest of Frankfort, followed by 6 miles of Genesee which finally goes under drainage one mile southwest of Reeses Mill, after which the outcrop is Portage to the southern termination of the fold.

Bedford Syncline.—The Bedford Syncline of Stevenson,[13] described later by O'Harra as the "Evitts Creek" Syncline in his Report on Allegany County, appears to be well defined in Pennsylvania several miles north of Bedford. Passing southwestward through Bedford town and soon reaching the headwaters of Evitts Creek it follows the valley of this stream through the southern part of Bedford County and entirely across Allegany County to the mouth of the creek where it enters West Virginia. From this point southward it remains in West Virginia 1½ miles, then recrosses into Maryland for 1.8 miles and finally enters definitely into West Virginia territory 1.4 miles west of North Branch Station (Baltimore and Ohio Railroad). From this locality its course is southward for 1½ miles after which it turns southwestward and so continues for many miles. It crosses Plum Run 1.4 miles west of its mouth, Tanners Run 1.8 miles southeast of Knobly, and Cabin Run 1.8 miles northwest of Reeses Mill. Continuing southwestward nearly parallel to the upper course of Cabin Run for several miles it crosses Mill Creek at Markwood, Mikes Run at Red Star School, and the Mineral-Grant County Line 1.6 miles northwest of Patterson Creek. In Grant County it crosses Thorn Run 1.6 miles southeast of Martin, North Fork of Patterson Creek 1.4 miles northwest of Medley, and Middle Fork 2.3 miles southwest of the same village. Crossing Lunice Creek just east of Johnsonville School, 1.8 miles southwest of Old Arthur and Norman Run 2 miles west of its mouth, it then turns southward and reaches South Branch of Potomac River 2 miles west of Petersburg. After crossing South Branch it turns southwestward again and apparently dies out on the northern slope of Cave Mountain 2 miles southwest of Royal Glen Mill.

In that portion of its length between North and South

[13]Ibid., pp. 20-22.

Branches of the Potomac this syncline is the principal structural depression east of the Allegheny Front in the two counties, its gathering basin, or trough, varying from 4 to 8 miles in width. Owing to the incompetent nature of the strata through which it passes the dips vary greatly, portions of its length being apparently quite symmetrical while some sections indicate excessive dips on the east and at other localities they occur on the west.

The surface geology along its axis in West Virginia is largely that of the Chemung and Portage Series of the Upper Devonian. Along the bends of North Branch of the Potomac the outcrop is entirely Portage but south of that locality the Chemung appears in the ridges and is also present in the valley of Tanners Run. In Horseshoe Mountain there is another extensive body of Chemung and south of Cabin Run it again appears in a narrow belt which gradually widens southward until it is 2½ miles wide just north of Mikes Run where the deepest portion of the basin appears to lie. From Mikes Run southward the Chemung gradually narrows until it finally disappears in the ridge just north of Thorn Run and northwest of Williamsport.

From Thorn Run southward there is an uninterrupted outcrop of Portage for 14 miles, its width varying from 2 to 3 miles. Two miles north of South Branch of the Potomac the Portage disappears and after a narrow belt of Genesee the Hamilton Shale makes the surface, but this also disappears above the rapidly rising axis just north of South Branch and the Marcellus Shale is the outcrop across the river valley and into the foot of Cave Mountain, the length of this section being 1½ miles. Along the last two miles of the axis the Oriskany Sandstone is present.

Broadly speaking the course of the Bedford Syncline and some of the less prominent folds parallel to it comprises a great topographic and structural synclinorium between the great uplift in Patterson Creek Mountain on the east and Knobly and New Creek Mountains on the west, as the Upper Devonian shales and thin sandstones which occur along this belt do not resist erosion like the hard rocks of the mountains named, but directly along the Bedford Syncline itself there is usually a pronounced topographic elevation, due to the fact that both the Portage and the Chemung, and the latter in particular, which occur along it, are much more resistant than the Hamilton and Marcellus Shales which come to the surface farther out along its flanks.

Wills Mountain Anticline.—The Wills-Dunning Anti-

cline of Stevenson,[14] described by O'Harra under the name of the "Wills Mountain Anticline," is by far the most predominant structural arch that occurs anywhere within the two counties. The structural relationship which gave rise to the double name of the arch in Bedford County is set forth succinctly in the following paragraph by Dr. Stevenson in the citation given:

"This great axis enters Bedford county at the south and its course thence to the Juniata river is indicated by the bold mountain ridge known as Wills mountain. Before reaching the river the mountain breaks down, and thence northward to beyond Dunning's creek the course of the comparatively gentle anticlinal is not marked by a mountain ridge but by a broken, gently rolling area eroded from rocks of the Upper Silurian. Northward from Dunning's creek, the energy of the fold quickly increases, until its course is shown by the abrupt ridge known as Dunning's mountain. It is altogether probable that the axis of Wills mountain is not directly continuous with that of Dunning's mountain, but that the former disappears northward as the other increases, so that the two axes overlap in the space between the two mountains. This, however, is merely conjecture, as exposures are somewhat indistinct."

In view of the probability that the arch in Dunning Mountain is not a true extension of the Wills Mountain uplift it would seem that the elimination of the northern mountain from the title by O'Harra was quite proper, and his abbreviation of the nomenclature will therefore be employed in this Report.

From the Pennsylvania-Maryland Line southwestward the axis of the Wills Mountain Anticline follows closely the high ridge of Wills Mountain, passing through the narrows of Wills Creek 1½ miles northwest of Cumberland and continuing with the same mountain to its southern end just north of Cresaptown, Allegany County. Here the arch veers slightly to the southeast and crosses a westward bend of North Branch of the Potomac one-half mile southeast of Cresaptown, but remains on the West Virginia side only 0.8 mile, as the river bends eastward again while the arch again turns southwestward. One mile farther it again crosses into West Virginia at a point 0.8 mile east of Potomac Station, and then so remains. From the Potomac River the arch retains its general southwesterly course entirely across both Mineral and Grant Counties. For nearly twelve miles it follows along the western slope of Knobly Mountain, but south of Limestone Run and about 1½ miles southeast of Keyser its axis goes directly with the summit of Abrams Ridge for 4 miles, and then extending through 2½ miles of

[14]Ibid., pp. 16-20.

low topography south of the ridge, it passes into the main backbone of New Creek Mountain about 1.7 miles northeast of Claysville, Mineral County. From this point southwestward it follows directly with New Creek Mountain for approximately 27½ miles, being well exhibited in Greenland, Cosner, and Kline Gaps where minor streams have cut great channels across it.

At the southern end of New Creek Mountain, Grant County, it crosses North Fork of South Branch of Potomac River, its cross-section being displayed in the magnificent North Fork Gap where the river has cut a passage more than 2,000 feet in depth. From the southern end of New Creek Mountain across the gap to the Chimney Top at the northern end of North Fork Mountain the distance is 2 miles. From Chimney Top southwestward to the Pendleton County Line, 4½ miles, the axis follows parallel to, and about one-third mile west of, the summit of North Fork Mountain, which is simply a further extension of the New Creek range under a different name. The total length of this great arch through Mineral and Grant Counties, from its last crossing of North Branch of Potomac to the Pendleton Line is therefore approximately 52½ miles.

In Pendleton County the same fold has been mapped by Darton[15] under the name of "North Fork Mountain Anticline" for a farther southwesterly distance of 24 miles, and after a gap of approximately 9 miles in which no detailed study of the geology has been made, what appears to be the same uplift has been further delineated by the same authority[16] in Highland and Bath Counties, Virginia, for a distance of 40 miles.

A review of the extent through which this great anticline has been determined reveals the fact that it is defined for 24 miles in Bedford County, Pennsylvania, 13 miles in Allegany County, Maryland, and along the bends of the North Potomac where it is partly in Maryland and partly in West Virginia, 52½ miles in Mineral and Grant Counties, West Virginia, and 73 miles in Pendleton County, West Virginia, and Highland and Bath Counties, Virginia, making a total of 162½ miles.

Throughout its length in Mineral and Grant Counties this anticline is asymmetrical at nearly all points, the dips being much steeper on western than on the eastern side, and

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[15]N. H. Darton, Franklin Folio, No. 32, United States Geological Survey; 1896.

[16]N. H. Darton, Monterey Folio, No. 61, United States Geological Survey; 1899.

conforming with the general Appalachian rule of Rogers. Its greatest depression in the two counties is in the section between North Branch of Potomac River and Abrams Ridge where the top of the White Medina Sandstone is under drainage at all points, the extreme low saddle being probably near O'Neil Gap, and its greatest elevation is between North Fork Gap and the Pendleton County Line where its horizon on the crest, if preserved from erosion, would at some points be certainly more than 3,500 feet above sea-level and at some points probably 4,000 feet. Surface outcrops near O'Neil Gap indicate that the Medina would be near sea-level, so that the total southwestward rise along the axis must approximate 4,000 feet.

The surface geology along the axis in the two counties is predominantly that of the White Medina Sandstone. At the North Branch of Potomac the Clinton Shale is the outcrop, followed by Niagara, Bloomsburg, Rondout, and Bossardville, along the slope of Knobly Mountain, but beyond O'Neil Gap the measures rise again so that the White Medina makes its appearance in the top of Abrams Ridge. It declines again in the low topography beyond the ridge, leaving the Clinton as the outcrop but appears at the north end of the principal ridge of New Creek Mountain and composes the backbone of the arch for many miles. At Dolls Gap, Mineral County, there is an outcrop of Red Medina and the same rocks appear more prominently at Greenland Gap, Grant County. Between Greenland and Kline Gaps the arch is somewhat depressed, causing the White Medina to be under the top of the mountain at two points, but it is still so high that the Red Medina makes a considerable outcrop in Cosner Gap which lies between the two saddles. At North Fork Gap the Red and Gray Medina are exposed, and also the Martinsburg Shale of the Ordovician, the former two being entirely and the latter one partly above drainage, while the White Medina crowns the summits north and south of the gap. In the region south of North Fork Gap the White Medina is eroded from the crest of the arch, but forms the backbone just eastward and on the west side stands in a practically vertical wall at numerous points half-way down the mountain slope. Between the two outcrops there is a long outcrop of Red and Gray Medina almost entirely concealed by debris from the massive cliff of the mountain, and also some slight outcrops of the Martinsburg Shale.

Rawlings Syncline.—The Rawlings Syncline of O'Harra[17]

[17]C. C. O'Harra, Allegany County Report, Maryland Geological Survey, pp. 149-150; 1900.

is a short depression that enters Mineral County from Maryland 0.7 mile southwest of Rawlings. Its northeastward extent is not described but in West Virginia it may be traced from the Potomac southwestward for approximately five miles, its axis being coincident with Ashcabin Run and ending on the western slope of Knobly Mountain 1½ miles southeast of Dawson. At the Potomac River Marcellus Shale is exposed but at the southern end the outcrop is Oriskany Sandstone.

Noswad Anticline.—The Noswad Anticline, not previously named or described, is a narrow but rather violent uplift crossing North Branch of Potomac 1.8 miles southwest of Rawlings and extending southwestward into Mineral County nearly 4 miles, its southern end being 1.2 miles southeast of Dawson. At the Potomac the Rondout Waterlime is exposed but at the southern end the outcrop is Helderberg. Northeast of the river in Maryland it appears to die out against the face of the more superior Fort Hill Anticline.

Noswad Syncline.—The Noswad Syncline, not previously named or described, is a short, narrow basin that appears to originate on the slope of the Fort Hill Anticline 1.5 miles southwest of Rawlings, in Allegany County, Maryland, and passing southwestward crosses the bends of the Potomac five times, finally dying out against the northern end of New Creek Mountain about three-fourths mile southeast of Keyser. Along the northeastern end the outcrop is Helderberg Limestone but the Oriskany appears three-fourths mile southeast of Noswad, followed by a narrow strip of Marcellus Shale in the region southeast of Twentyfirst Bridge where the deepest part of the basin appears to lie. At the mouth of Limestone Run the Oriskany makes a conspicuous outcrop and continues as the surface member to the southern end.

Fort Hill Anticline.—The Fort Hill Anticline of O'Harra[18] is a short, but violent, uplift that has its beginning at the northeastern end of Fort Hill, just west of Rawlings, Allegany County, Maryland, and traversing the length of that ridge southwestward for 4½ miles, crosses the Potomac 0.7 mile northeast of Dawson. It then remains in Mineral County for nearly 3 miles but crosses into Maryland one-fourth mile southeast of Twentyfirst Bridge, passing through Queens Point just north of Keyser and then crossing the Potomac again and dying out against the northern end of New Creek Mountain opposite the end of the Noswad Syncline. Throughout its length it is a narrow, sharp fold

[18]Ibid., pp. 150.

Photo by E. E. HARRIS.

PLATE V.—View of Petersburg looking north across valley of South Branch of Potomac River. Hamilton and Marcellus Topography in foreground. Low hills in left background are principally Portage, followed by Knobly and New Creek Mountains in extreme rear. Charles Knob of Patterson Creek Mountain on right is anticlinal and capped by Bossardville Limestone. Cleared slope at extreme right is Oriskany.

along which the Oriskany Sandstone makes several conspicuous outcrops, among which is Queens Point, but at the first crossing of the Potomac northeast of Dawson the Rondout Waterlime is exposed and at the crossing southeast of Twenty-first Bridge a small part of the Helderberg is visible.

Beaver Run Anticline.—The Beaver Run Anticline, not previously named or described, is an offshoot from the great Patterson Creek Mountain fold from which it separates 1.7 miles southwest of Russelldale, southeastern Mineral County. From its origin it extends in a northeasterly direction, passing 0.4 mile east of Russelldale and thence following just west of the Mineral-Hampshire County Line for 3.7 miles, after which its course is approximately with the valley of Beaver Run, being first on the west side of this stream and then crossing to the east side about one-half mile below Beaver Run School. Beyond the mouth of Beaver Run it apparently dies out near Dowden Run, 1.2 miles northeast of Headsville, the total length of the arch as mapped being 11 miles. Throughout its length it is a low, symmetrical fold, with an axis plunging northeastward along which the Helderberg Limestone is exposed at the extreme southern end, followed by Oriskany Sandstone which forms the crest for 2½ miles farther and again barely reappears at the Northwestern Pike. The Marcellus Shale makes an outcrop of nearly two miles just south of the pike and again north of it for 1½ miles, after which the Hamilton Shale is present for more than three miles followed by Genesee and Portage, the latter being the outcrop where the fold seems to disappear at the northern end.

Russelldale Syncline.—The Russelldale Syncline, not previously named or described, is a shallow basin which originates between the Beaver Run Anticline and the main Patterson Creek Mountain fold about one-half mile southeast of Russelldale, southeastern Mineral County. Passing northeastward it crosses the Northwestern Pike 1¼ miles east of Burlington and then extends approximately parallel to Patterson Creek, finally seeming to die out one mile south of Headsville, its total length being 8 miles. Along its course the axis gradually declines northeastward, the surface outcrop at the southern end being Marcellus Shale, followed by Hamilton, which makes the surface in the vicinity of the pike, and by the Genesee and Portage, the latter being present at the northern end.

Elliber Syncline.—On a cross-section northwestward along the line between Mineral and Grant Counties the first structural wrinkle is the Elliber Syncline, a basin which has not been previously named or described. This depression

appears to originate in Grant County at the head of Elliber Run, just northeast of Twin Mountain town, and passing northeastward into Mineral County with the course of the stream for four miles it then deflects more to the eastward, crossing the Mineral-Hampshire Line at a farther distance of 1.8 miles, and one-half mile southeast of Russelldale, beyond which it has not been mapped, its total length as indicated being 5.8 miles. Throughout its course it is an extremely narrow, symmetrical basin, with the cherty member of the Helderberg Limestone cropping along its southern half and the Oriskany Sandstone along its northern half.

Patterson Creek Mountain Anticline.—The Patterson Creek Mountain Anticline, not previously named or described, is an immense uplift which first becomes noticeable on Elliber Run, just northwest of Russelldale, Mineral County. As already mentioned, page 104, it seems probable that this fold may be a continuation of the Tussey Mountain Anticline but positive proof of such a theory is lacking and it is therefore mapped as an independent fold. At its northern end it has several branches, among which are the Beaver Run Anticline and another short fold just west of Cave Run, but these are much less prominent than the main arch, although the Beaver Run Anticline extends much farther northward.

Starting at Elliber Run the Patterson Creek Mountain Anticline follows one of the twin ridges that occur at the north end of the mountain, and five miles farther southwestward crosses into Grant County. With a general south-southwesterly direction it then passes just west of Twin Mountain town, one mile east of Williamsport, 2 miles east of Medley, 2.2 miles east of Forman, 2.3 miles east of Lahmansville, 2.1 miles east of Arthur, 1.6 miles east of Seymourville, directly through Charles Knob, Lunice Creek just east of Petersburg, and crosses South Branch of the Potomac River one-half mile southeast of the court-house at Petersburg, and appears to die out completely about 1¼ miles beyond the river. Throughout most of the region mentioned between Elliber Run and Lunice Creek its course is mainly with the ridge of Patterson Creek Mountain, except that erosion in several localities has given the summit of the mountain an irregular line that does not now correspond with that of the arch. Its entire length as mapped is 25½ miles but in the region of Elliber Run and in that south of Lunice Creek it is inconspicuous.

In general aspect this anticline is like a vast inverted canoe, with its high point in the section opposite Williams-

port, Medley, and Forman, and featured by several minor corrugations along its flanks. It is much more symmetrical than the Wills Mountain Anticline of New Creek Mountain, the extremely steep dips which characterize the latter fold being absent. Besides other minor folds already described near the northern end there is a short syncline and a corresponding anticline in the region just east of Medley, occurring on the western flank of the main arch, and several more at the southern end which will be defined in subsequent pages.

The surface geology is largely that of the Devonian and Silurian Limestones. At Elliber Run, near Russelldale, the Helderberg is partly above drainage and constitutes the crest in Mineral County and southward into Grant for 1½ miles but in the region east of Williamsport, where the axis passes across the heads of two deeply eroded tributaries of Patterson Creek, the measures are exposed down to the Niagara and Clinton Series, respectively, of the Silurian. From this locality southward no Clinton appears to outcrop on the Grant County side of the line but it may possibly be above drainage in Hardy County where the arch crosses the headwaters of deeply eroded minor streams. In the region opposite Medley, Forman, Lahmansville, and Arthur, there are long exposures of Rondout Waterlime and Niagara but at Charles Knob where the arch has begun to decline and the topography is high the Bossardville appears to make the ridge. Between this point and Lunice Creek there is a short outcrop of Helderberg, followed by a broad covering of Oriskany Sandstone which extends down to the highway near the mouth of the creek. South of Lunice Creek and across the valley of South Branch the surface is made by Marcellus Shale, followed by an exposure of Hamilton at the southern end of the arch.

Laurel Dale Syncline.—Farther west along the line between the two counties minor folds occur on the western flank of the Wills Mountain Anticline. Of these the Laurel Dale Syncline, not previously named or described, apparently originates 0.7 mile southeast of Claysville and passing southwestward within one-third mile east of Laurel Dale finally appears to die out near the head of New Creek, its length as mapped being 9 miles. A further minor flexure, having the same direction and bearing the same relationship to the Wills Mountain Anticline, is plainly visible along the road one-half mile west of Greenland and extends to the waters of Lunice Creek 0.7 mile northwest of Brick Church. The latter depression is possibly an extension of the Laurel Dale Syncline but there is no visible proof of any basin for two miles south

of the latter and they are therefore shown as disconnected synclines on the map.

Along the Laurel Dale Syncline the surface geology is entirely that of the Rondout Waterlime which makes a scarcely perceptible depression along the steep slope of the mountain where the basin occurs, but just west of the axis there are occasional outcrops of the hard sandstone member of the Bloomsburg Red Shale, the reverse dips of which clearly indicate the presence of the syncline. Along the other basin mentioned farther south there are small outcrops of Oriskany Sandstone at the northern end, followed by Helderberg in the valley west of Greenland and then by another outcrop of Oriskany and by a narrow belt of Marcellus Shale near the southern end.

Laurel Dale Anticline.—The Laurel Dale Anticline, not previously named or described, lies scarcely one-fourth mile west of the Laurel Dale Syncline and is of approximately the same length. At the northern end its location is in the foot of New Creek Mountain just east of New Creek, but one-half mile south of Mountain Valley School it descends to the creek valley and follows the same to its head. In the region west of Greenland a similar uplift occurs at a corresponding distance west of the minor syncline described above, and this may be an extension of the Laurel Dale arch but evidence of such connection is lacking. Along the Laurel Dale Anticline proper the Niagara Limestone is the principal outcrop but in the southern arch the Helderberg is present at the northern end, with a brief outcrop of Bossardville in the valley west of Greenland, followed by Oriskany southward to the end.

Middle Mountain Syncline.—Passing now to a hypothetical cross-section from Durgon, Hardy County, slightly north of west toward Jordan Run, Grant County, the first structural feature is the Middle Mountain Syncline of Darton.[19] This basin was observed as far north as Hutton Run of South Branch of Potomac, 0.6 mile west of Fisher, Hardy County, its further extent in this direction not having been studied. From this point mentioned southwestward it crosses South Branch 0.6 mile northwest of Durgon, enters Grant County one-fourth mile east of Durgon Run and 3.2 miles southeast of Petersburg, crosses South Mill Creek 0.8 mile south of Dorcas, and then crossing the northern end of Middle Mountain 0.4 mile east of Mt. Hope School follows southwestward along this range slightly west of its summit to the Pendleton

[19] N. H. Darton, Franklin Folio, No. 32, United States Geological Survey; 1896.

County Line. In Pendleton the mountain declines southward but the syncline is plainly visible on Brushy Run of North Mill Creek 1.6 miles southeast of its mouth. According to the map of Darton the same basin appears to continue southwestward until it reaches the South Branch Valley southeast of Upper Tract and to follow the same closely to Franklin.

This syncline is of symmetrical cross-section with an axis plunging gently southwestward from Fisher and Durgon, but opposite Pansy and Landes it begins to rise and appears to so continue toward Franklin. At the Grant-Hardy County Line there is a broad outcrop of Portage Shale, but the Chemung appears in the northern end of Middle Mountain and makes the surface to the Pendleton County Line, the outcrop at the point where the basin crosses Brushy Run being Portage.

Welton Anticline.—The Welton Anticline, not previously named or described, is a fold which originates between the Middle Mountain and Hiser Synclines about three-fourths mile west of Dorcas, Grant County. From this point it extends northeastward, passing through the forks of Mill Creek just east of Hiser and thence following a high topographic ridge to South Branch of Potomac River which it crosses one-half mile west of Welton. Northeast of the river it crosses the Hardy County Line 0.8 mile northwest of Welton and five miles farther on it crosses the highway one-fourth mile east of Kessel, Hardy County. Beyond this point its alignment has not been determined.

Contrary to the general rule the dips on the eastern side of this anticline appear to be more rapid than on the western flank, but its axis lies nearer to that of the Hiser Syncline on the west than to the Middle Mountain Syncline on the east, due to the fact that the latter is a deep basin while the former is much more shallow. At the southern end the surface geology is that of the Portage Series but the axis rises rapidly toward South Branch, bringing up the Genesee, Hamilton, and Marcellus in the vicinity of Hiser, while the Oriskany forms most of the ridge farther northeast. In the deep gap of South Branch west of Welton the entire Helderberg and part of the Bossardville are exposed, and faulting, which is plainly visible in the bluff south of the river, has occurred in the Oriskany and Helderberg. In the portion of the arch indicated in Hardy County the geology has not been mapped but the Oriskany is the predominant surface outcrop, there being an exposure of the upper portion of the Helderberg east of Kessel.

Kessel Syncline.—The Kessel Syncline, not previously named or described, is a sharp and extremely narrow basin lying just west of the Welton Anticline. It appears to originate in the wide valley of South Branch 1.2 miles east of the Petersburg court-house, and passing northeastward crosses the Grant-Hardy County Line 1.5 miles north of Welton. From this point it extends northeastward, passing through the village of Kessel and thence down the valley of Walnut Bottom Run, its presence being plain just west of Walnut Bottom School, beyond which it has not been studied. At the southern end the outcrop is Marcellus Shale, but the axis rises and the Oriskany is the principal surface rock in Grant County.

Kessel Anticline.—The Kessel Anticline, not previously named or described, is a sharp, narrow fold of moderate uplift occurring between the Kessel and Hiser Synclines. It originates in the valley of South Branch 1.1 miles east of Petersburg, and extending northeastward crosses the Hardy County Line 1.2 miles north of Welton. From this point it continues to the vicinity of Kessel, Hardy County, where it crosses the public road one-fourth mile west of the village, beyond which its position has not been studied. At the southern end there is a brief outcrop of Marcellus Shale in the valley but the Oriskany Sandstone appears at the Petersburg-Moorefield road and seems to continue as the surface member to the northern limit to which the arch has been mapped.

Hiser Syncline.—The Hiser Syncline, not previously named or described in detail, appears to have its beginning near the northern end of Middle Mountain near Mt. Hope School, Grant County, having been mentioned by Darton in the Franklin Folio as an offshoot from the Middle Mountain Syncline. From this point it extends nearly northward, crossing North Mill Creek one mile southwest of Hiser, and then turning northeastward crosses South Branch 0.8 mile southeast of the Petersburg court-house, and the Grant-Hardy Line 1.8 miles north of Welton. In Hardy County it has been traced as far as Kessel where it crosses the public road 0.4 mile west of the village, but beyond this place it has not been studied.

At the northern end of Middle Mountain its axis starts in the Chemung but the Portage appears half-way down the slope of the mountain and continues as the surface outcrop to a point about one mile north of Hiser, where the Genesee and Hamilton come above drainage. Across the wide bottom of South Branch the Marcellus Shale is present and its outcrop extends about one-half mile up the narrow ravine

north of the Petersburg-Moorefield road, after which the Oriskany appears and is present to the head of Frosty Hollow, down which the Marcellus is again present to the northern limit to which the basin has been mapped.

Minor Synclines near Petersburg.—Just west of the Patterson Creek Mountain Anticline, already described, there is a short, shallow basin passing northeast and southwest through the western edge of Petersburg. This depression crosses South Branch about one-third mile northwest of the Baltimore and Ohio Railroad station and may be traced southwestward from this point about one mile and northeastward about two miles, dying out against the end of Patterson Creek Mountain. The surface outcrop through Petersburg is the Marcellus Shale but the Hamilton is present at the southern end of the basin and the Oriskany at the northern extremity, indicating an axis that rises rapidly northeastward.

West of the northern end of the basin just described there is another short syncline that is very pronounced for three miles, starting in the broad valley of Lunice Creek about one mile north of Petersburg and extending northeastward up one of the tributaries of the creek until it finally disappears against the steep western slope of Patterson Creek Mountain one mile southeast of Seymourville, being marked throughout most of its length by an outcrop of Marcellus Shale.

Cave Mountain Anticline.—The Cave Mountain Anticline of Darton,[20] which occurs west of the minor synclines just described, is one of the major uplifts of southern Grant County. Starting on the western slope of Patterson Creek Mountain, 0.7 mile southeast of Seymourville, this arch extends southwestward, crossing South Branch 1.3 miles west of the Petersburg court-house, and thence following up one of the ridges of Cave Mountain just east of Sawmill Run and coinciding with the summit of the main ridge one mile east of Blue Rock. Beyond this point it lies west of the mountain and crosses one of the tributaries of South Branch at the Shoock School, cuts across the wide bend of the river just southeast of Ketterman School and reaches the Pendleton County Line 0.6 mile southeast of the schoolhouse. In Pendleton County it is described by Darton as passing through Big Mountain and Castle Mountain.

At the northern end this anticline is a sharp, narrow fold, covered by Oriskany Sandstone for three miles but in the valleys of Lunice Creek and South Branch it dies down to a

[20]N. H. Darton, Franklin Folio, No. 32, United States Geological Survey; 1896.

low uplift over which the Marcellus outcrops. South of Johnson Run there is another long outcrop of Oriskany along the rapidly rising axis and in the summit of the mountain beyond the head of Sawmill Run there are outcrops of Helderberg and Bossardville Limestone. Near Shoock School the measures are exposed down to the upper portion of the Clinton Shale and the White Medina Sandstone is visible in the large bend of South Branch near the Pendleton County Line.

Sawmill Syncline.—Of the several minor corrugations that occur near the northern end of Cave Mountain, the Sawmill Syncline, not previously named or described, lies just west of the Cave Mountain Anticline, being about 4 miles in length and principally occupying the valley of Sawmill Run. Its axis rises rapidly southwestward, the outcrop at the northern end being Marcellus Shale and at the southern end Helderberg Limestone.

Sawmill Anticline.—The Sawmill Anticline, not previously named or described, lies westward from and parallel to the Sawmill Syncline and is of about the same length. Starting with an outcrop of Marcellus Shale in the valley of South Branch, the axis rises southwestward until the Helderberg is found at the surface along the southern end.

Royal Glen Anticline.—Westward beyond the Bedford Syncline, which has already been described, lies the Royal Glen Anticline, named and detailed for the first time in this Report. This fold appears to have its most northern visible expression on a branch of Norman Run of Lunice Creek, one-half mile northeast of Quantico School and 4½ miles northwest of Petersburg. Passing in a southerly direction across Robinson and Hoglan Runs it crosses South Branch at Royal Glen Mill and then turning southwestward apparently disappears as a separate fold about one mile northeast of Blue Rock. In the region north of Hoglan Run there is an extensive outcrop of Hamilton Shale but south of this stream the Marcellus appears, followed by Oriskany Sandstone and the cherty member of the Helderberg Limestone in the river bluffs at Royal Glen Mill, the outcrop beyond this point being Oriskany Sandstone.

Blue Rock Syncline.—The Blue Rock Syncline, not previously named or described, is the principal basin between the Cave Mountain and Wills Mountain Anticlines of southern Grant County. Starting at the north about one-fourth mile west of the northern end of the Royal Glen Anticline and 0.4 mile northeast of Quantico School it extends southward and southwestward approximately the same distance

from and parallel to the Royal Glen Anticline for the entire length of the latter uplift, its presence on South Branch being plainly visible one-fourth mile west of Royal Glen Mill. Farther south it again reaches South Branch just west of Blue Rock and thence follows the valley southwestward, crossing the meanders of the river several times. At the Pendleton County Line its axis is about one-fourth mile west of the river, but it again touches the stream at Ketterman and crosses to the eastern side at Maple Dale School. Farther south, according to the areal map of Darton it appears to lie near the western bases of Big Mountain and Castle Mountain.

North of Blue Rock this basin appears to be somewhat regular and symmetrical but south of this point there ensues a region of broken and distorted outcrops, followed by an overthrust fault of considerable proportions near the Pendleton County Line that will be described in more detail on a subsequent page.

The outcrop at the northern end of the syncline is Hamilton Shale, but the Marcellus appears just north of the Petersburg-Hopeville road and continues beyond the first crossing of South Branch, after which the Oriskany is present for nearly four miles. From Blue Rock southwestward the Bossardville and Helderberg Limestones are present in the valley for a few miles with small areas of Oriskany in the high points but at the fault near the Pendleton Line these limestones are mostly covered by an overthrust of Oriskany.

Peacock Cave Anticline.—The Peacock Cave Anticline, named and described for the first time in this Report, is a short structural ridge, originating in the bluffs north of South Branch about three-fourths mile northwest of Royal Glen Mill. Crossing the river about the same distance west of the mill it extends southwestward for four miles and seems to die out or become unrecognizable in the vicinity of Peacock Cave, which seems to have been caused in part by the highly fractured condition of the limestones of this locality. At the northern end of the anticline there is a brief outcrop of Marcellus Shale but the Oriskany appears in the bluffs of South Branch at the crossing and continues southward nearly to the cave, at which the outcrop is Helderberg. Along the western slope of this anticline there is an extensive fault that will be described on a subsequent page.

Corners Syncline.—The Corners Syncline, not previously named or described, is a short basin which originates near the eastern base of Knobly Mountain about one-half mile north-

east of Corners and passing southwestward and crossing North Fork of South Branch and then South Branch itself, passes up the valley of the latter and appears to die out against the eastern slope of the great Wills Mountain Anticline in the vicinity of Shirk Gap. The principal outcrop along it is Marcellus Shale but at the southern end where the axis suddenly rises the Oriskany and Helderberg appear in Shirk Gap.

Hopeville Syncline.—On the western flank of the Wills Mountain Anticline in this portion of Grant County, there are two minor corrugations that merit attention. The Hopeville Syncline, not previously named or described, appears to originate on the eastern side of Jordan Run about 2 miles south of Jordan Run Post-office. Passing southwestward through the Hopeville Gap, where it is plainly visible, it extends up the valley of North Fork of South Branch, crossing the meanders of the stream several times before it reaches the Pendleton County Line, being named from the village of Hopeville which lies about one-third mile west of the axis. The outcrop along its length is partly Marcellus Shale and partly Oriskany Sandstone.

Hopeville Anticline.—The Hopeville Anticline, not previously named or described, is a narrow but exceedingly sharp fold, lying west of and approximately parallel to the Hopeville Syncline. Originating on Jordan Run north of Hopeville Gap, it passes through the gap and then up the valley of North Fork, mainly but not entirely on the western side. Its axis lies just east of Hopeville and farther south at the Grant-Pendleton Line it is slightly east of North Fork but in the latter county soon crosses to the western side and is prominent for nearly two miles but appears to die out suddenly in the vicinity of Shafter Run and Pleasant Valley Church. Throughout almost its entire length it is featured by steeply dipping outcrops of Oriskany Sandstone.

Deep Spring Syncline.—The Deep Spring Syncline, not previously named or described, is a comparatively shallow basin that occurs in the extreme southeastern corner of Grant County. As delineated on Map IV it extends from the vicinity of the Ketterman School, 2 miles west of Brake, Hardy County, southwestward approximately parallel to and slightly west of the summit of South Fork Mountain, passing into Grant County 1.2 miles southwest of the schoolhouse and being plainly visible on the public road one-third mile east of Deep Spring School, and crossing into Pendleton County one-fourth mile northwest of the common corner of that county with Hardy and Grant. About one-half mile southwest of the Grant-Pendleton Line it divides into two basins

of which the western is the more prominent. This syncline follows down Shaver Run to the point where the stream suddenly turns westward toward Kline. Beyond the point mentioned its axis has not been delineated. The eastern branch of the basin lies about midway between the main syncline and the summit of South Fork Mountain and was traced for nearly 3 miles south of the Grant County Line. The northeastward extension of the Deep Spring Syncline beyond the Ketterman School in Hardy County has not been determined. The surface outcrop in Grant County is the Oriskany Sandstone.

Elkhorn Mountain Anticline.—The Elkhorn Mountain Anticline, not previously named as such, but described in part by Darton, is a major uplift of southeastern Grant County. According to Darton[21] the principal anticline of this region is named as the "Long Ridge-South Branch Mountain Anticline" and is described as extending from Long Ridge, Pendleton County, northeastward in a somewhat broken succession, to the Grant County Line, and he states further that an anticline in Sweedlin Hill, Pendleton County, passes northward and becomes the great arch of Elkhorn Mountain. With this interpretation the writer can not fully agree, as the Deep Spring Syncline appears to intervene and fully preclude the hypothesis that the Sweedlin Hill fold could pass through Elkhorn Mountain and that being the case the nomenclature of Darton can not properly apply to this locality.

The Elkhorn Mountain Anticline is an immense fold which comes from Hardy into Grant County just west of the Elkhorn Rock on Elkhorn Mountain and passing southwestward lies 0.7 mile west of Ketterman School, crosses Rough Run 1½ miles east of Rough Run Post-office, and the Pendleton County Line at the extreme head of Wolfpen Hollow. In the latter county it crosses Mill Run 1.3 miles east of Kline and 0.2 mile southwest of Greenawalt School, and would then appear to eventually reach and coincide with the Long Ridge fold of Darton.

At the Hardy County Line the anticline is capped by a massive deposit of White Medina Sandstone, but just west of the Elkhorn Rock this member of the Medina has been eroded leaving a deposit of the Red Medina on the slope of the mountain. Certain peculiarities of the dip indicate a small fault in this locality but the evidence of such is not positive. Southwest of the southern end of Elkhorn Mountain there are alternating deposits of Clinton and Niagara, but the axis

[21]Ibid.

declines and beds of Bloomsburg, Rondout, and Bossardville appear in the last 3¼ miles north of the Pendleton Line. In Pendleton County the arch is capped by White Medina Sandstone where it crosses Mill Run just west of Greenawalt School and five miles southwest of the Grant-Pendleton Line. From the Elkhorn Rock to Mill Run there is a structural drop of approximately 1,100 feet in 14½ miles, making a rate of 76 feet per mile.

In Hardy County, northeast of Elkhorn Rock, the anticline has not been studied in detail but it would appear that it rapidly declines northeastward and probably dies out almost completely before reaching the forks of South Branch of Potomac and Moorefield Rivers just south of Moorefield.

CROSS-SECTIONS.

Seven cross-sections have been prepared of the highly disturbed rocks lying east of the Allegheny Front, being mainly prepared by Mr. Tucker. All of these sections end at the Allegheny Front, west of which the structure is comparatively flat and has been more adequately portrayed by the structure contours previously described. The sections are drawn on a vertical scale of 1-62,500, or 5,208 feet to the inch, which is the linear scale of the topographic maps, and all of them extend approximately at right angles to the line of strike, some slight deviations being made from this rule to include certain interesting features.

Cross-Section AA′.—Cross-Section AA′, approximately 9½ miles long, starts three-fourths mile south of North Branch of Potomac River near the extreme northeastern corner of Mineral County and extends northwestward across Patterson Creek Ridge, Patterson Creek, and Knobly Mountain to the North Branch of Potomac just west of Seymour, as shown on Map II.

Cross-Section BB′.—Cross-Section BB′, approximately 12½ miles long, starts at the Mineral-Hampshire County Line, 4 miles west of Romney, and extends northwestward across Patterson Creek, Knobly Mountain, and New Creek to the Allegheny Front 3 miles west of Keyser, as exhibited on Map II.

Cross-Section CC′.—Cross-Section CC′, nearly 10 miles long, starts on Patterson Creek Mountain, just northeast of the common corner of Mineral, Grant, Hardy, and Hampshire Counties, and extends northwestward across the extreme southern edge of Mineral to a high knob on the Allegheny Front 1¼ miles southeast of Hartmansville, showing the Wills Mountain Anticline and other structural features that

mark the boundary between Mineral and Grant, as delineated on Map II.

Cross-Section DD'.—Cross-Section DD', 11 miles long, starts at the Grant-Hardy County Line, 2½ miles east of Forman, and extends northwestward across Patterson Creek and through the gorge cut by North Fork of this stream in Knobly and New Creek Mountains at Greenland Gap and on to the Allegheny Front 1½ miles east of Bismarck, as shown on Map IV.

Cross-Section EE'.—Cross-Section EE', approximately 12½ miles long, starts at the Grant-Hardy County Line 3 miles northeast of Petersburg, and extends northwestward across Patterson Creek Mountain, Lunice Creek, and Knobly and New Creek Mountains to the Stack Rock on the Allegheny Front 4¼ miles northwest of Jordan Run, as shown on Map IV.

Cross-Section FF'.—Cross-Section FF', approximately 16 miles long, starts on the Grant-Hardy County Line just south of Elkhorn Rock and extends northwestward across South and North Mill Creeks, South Branch of Potomac, and through the gap made by North Fork of South Branch between New Creek and North Fork Mountains, and reaches the Allegheny Front 3 miles northwest of Hopeville. As shown by Map IV this section exhibits the only outcrop of Ordovician rocks in either county.

Cross-Section GG'.—Cross-Section GG', 15½ miles long, starts near the extreme southeastern corner of Grant County and just northeast of its corner with Hardy and Pendleton, and extends northwestward across Middle, Cave, and North Fork Mountains to the Allegheny Front just north of the corner of Grant, Pendleton, and Randolph Counties, exhibiting the structure of southern Grant County, as shown by Map IV.

UNCONFORMITIES.

In passing down the geologic column of rocks exposed in Mineral and Grant Counties, the first unconformity, of other than purely local occurrence, is that which is found at the contact of the Pottsville Series of the Pennsylvanian with the underlying Mauch Chunk Series of the Mississippian. At this stratigraphic level the coarse and often conglomeratic sandstones of the upper coal measures rest upon red shales and green, flaggy, micaceous sandstones, almost totally devoid of coal and lacking most of the typical Upper Carboniferous flora, indicating an entirely different mode of accumulation and possibly long exposure to air and consequent erosion. It is well known that the same condition exists

wherever these beds occur throughout the entire Appalachian region.

Another unconformity is noticeable at the contact of the Pocono Series of the Mississippian with the Catskill Series of the Devonian. Here again there are heavy, coarse, gray sandstones overlying red shales and flaggy, micaceous sandstones, indicating a period of exposure and erosion. This condition is also wide-spread through the northern Appalachian region and becomes even more apparent in the southern States where the Catskill and several other series of the Upper Devonian entirely disappear. In the remainder of the Devonian no other unconformities of general extent appear except at its base where a long lapse of time is indicated by faunal data.

In the Silurian one is found at the base of the Rondout Waterlime where this member rests upon the red and green shales of the Bloomsburg Red Shale. Similar conditions again occur at the base of the White Medina Sandstone where this coarse and conglomeratic member rests upon the Red Medina shales, which must have been subject to a long period of exposure and erosion. At the base of the Silurian an angular unconformity is visible where the Gray Medina rests on the Martinsburg Shale in North Fork Gap, fossil marine life being absent in the former while in the latter it is abundant.

FAULTS.

In the region west of the Allegheny Front faults are not known to occur in the two counties, the competent strata of this region having apparently successfully resisted the forces of shear and thrust. In the region east of the Allegheny Front, however, there are several localities where there is visible evidence of displacement.

In Mineral County few faults of consequence are apparent, but the following quotation from O'Harra[22] indicates two that may extend across the Maryland Line into West Virginia:

"In the Jennings (Chemung and Portage) formation along Williams Road on the hillside near the eastern edge of Cumberland there is a fault whose throw seems to be considerable, but no definite idea as to the exact amount of displacement could be gained.

"On the Baltimore and Ohio Railroad west of Cedar Cliff, about three miles south of Cumberland, a small, clearly faulted anticline is seen in red shaly sandstone bands near the bottom of the Salina formation. The throw here is only a few feet."

Whether the fault at the former locality reaches south-

[22]C. C. O'Harra, Allegany County Report, Maryland Geological Survey, pp. 154; 1900.

ward into Mineral County is a matter of conjecture only, as its somewhat indefinite location would indicate that it was noticed a mile or more north of the Potomac, the wide valley of which would make it difficult to trace the break across the line. No evidence of its existence on the West Virginia side, however, was noted.

At the latter locality the fault mentioned occurs in the Bloomsburg Red Shale and its included sandstone member, the disturbed condition of the rocks being plainly visible, but at this point also there is a wide bottom on the West Virginia side of the Potomac that obliterates all evidence.

A further highly disturbed locality along the North Branch of Potomac is visible along the Baltimore and Ohio Railroad near Potomac Station on the Maryland side. Along the Cresaptown road just north of the station the Oriskany Sandstone and Helderberg Limestone have been overturned, the latter now occupying the superior position, quite contrary to the depositional succession. Going east from the station in the long cut along the railroad the rocks soon resume a vertical angle and finally assume the normal northwestward dip of the western flank of the Wills Mountain Anticline, but at about one-fourth mile east of the station there appears to be a duplication in Rondout Waterlime, the evidence of which is afforded at two old cement quarries where this limestone was formerly mined by tunnels driven northward along the strike of the vertical strata. As shown by the Potomac Section, published in Chapter V, an apparent horizontal and stratigraphic interval of 70 feet separates these two tunnels, but there is an almost exact recurrence of several stratigraphic peculiarities at each tunnel, among which is a bedding-plane that is marked by numerous weathered figures that much resemble huge fish scales nearly one foot in diameter. These odd designs do not seem to occur elsewhere in this exposure of the Rondout and their presence at both tunnels adds much weight to the other evidence.

Along either side of the Bedford Syncline and attendant flexures extending entirely across Mineral County and southward into Grant to the South Branch of Potomac River, there are numerous overturns and short faulted areas, of local significance only, in the Chemung, Portage, and other incompetent strata of the Upper and Middle Devonian.

It seems probable that few, if any, of these breaks and disturbances extend downward into the underlying competent strata of the Lower Devonian.

In the gap where South Branch of Potomac cuts across the southern end of Patterson Creek Mountain two miles east of Petersburg, faults occur near the point where the

Welton Anticline crosses the river. On the northern side of the river and on the western flank of the arch there is a visible break in the Oriskany Sandstone. Here the fault-plane appears to be nearly vertical, with a downthrow of approximately 50 feet on the eastern side. South of the river there is a double break just east of the axis of the anticline, where two blocks of Oriskany Sandstone occupy **en echelon**

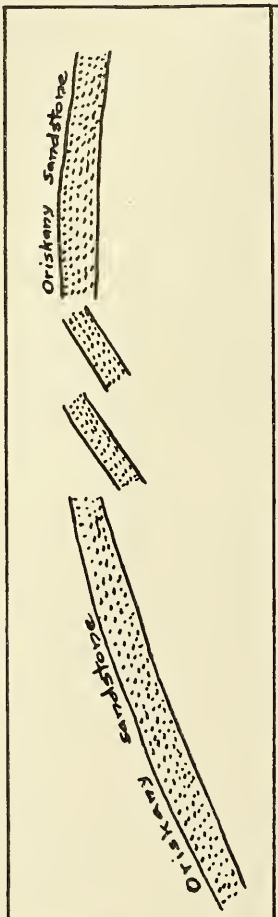

FIGURE 6.—Sketch showing Faults in Oriskany Sandstone just east of axis of Welton Anticline on south side of South Branch of Potomac River, 2 miles east of Petersburg, looking south; not drawn to scale.

R.C.T.

positions, as shown by Figure 6. The downthrow at the eastern end of each block appears to be from 50 to 100 feet but no actual measurements were made. This faulting also

Photo by E. E. HARRIS.

PLATE VI.—View from Pinnacle Triangulation Point looking southwestward along escarpment of Allegheny Front. This is capped by Pottsville and toward the left all formations down to the White Medina, which forms the summit of the anticlinal New Creek Mountain at extreme left, are successively exposed. Cleared field in middle is Greenbrier Limestone.

appears to extend downward into the underlying Helderberg Limestone but is less distinct, owing to debris from the cliff above. This locality is also shown by a photograph.

In the Smoke Hole Settlement along the South Branch of Potomac southwest of Petersburg there are two faults of considerable magnitude that are clearly visible, and doubtless others that may have escaped attention in this highly disturbed and broken region. One of these is first noticeable on the Petersburg-Hopeville road 0.9 mile east of Corners

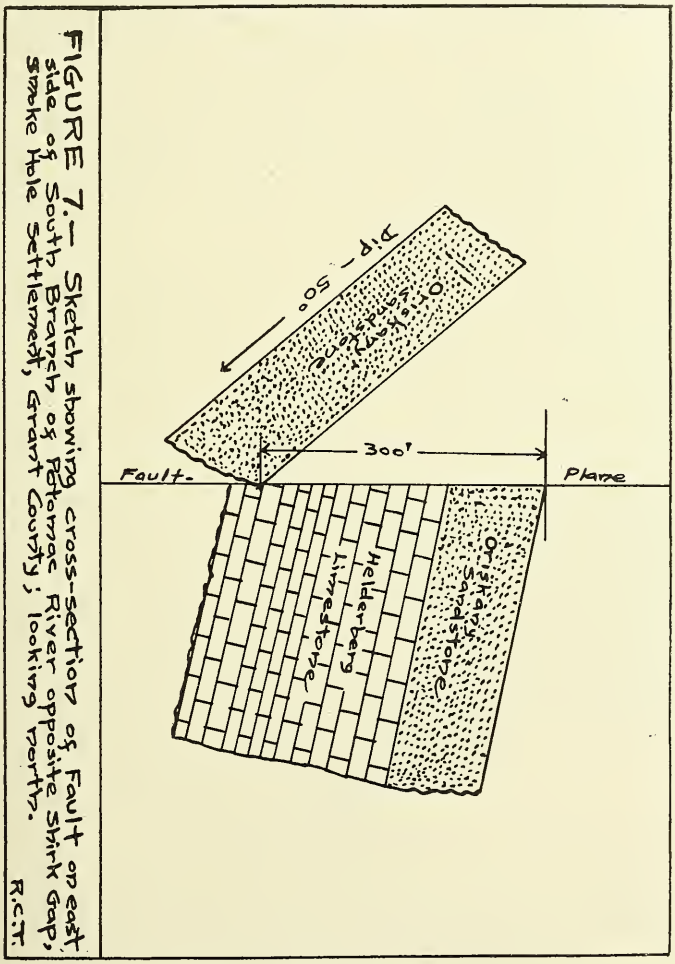

FIGURE 7.— Sketch showing cross-section of Fault on east side of South Branch of Potomac River opposite Shark Gap, Smoke Hole Settlement, Grant County; looking north. R.C.T.

where the Marcellus Shale, dipping southeastward, outcrops

on the eastern side of the fault-plane and the fossiliferous Hamilton Shale, dipping in the same direction, lies on the western, or downthrow side, no measurement of the displacement being possible. On South Branch, 0.3 mile east of the mouth of North Fork, the same fault is clearly visible in the Oriskany Sandstone, and from this point southwestward it appears to extend for at least four miles, its position being about one-fourth mile east of South Branch, as indicated on Map IV. In the bluff of the mountain east of and opposite Shirk Gap, it seems to reach its maximum development, where, as shown by Figure 7, the downthrow on the western side of the plane is estimated at 300 feet, according to the relative positions of the Oriskany Sandstone and Helderberg Limestone. Beyond the turn of South Branch above Shirk Gap the further extent of the fault southward, if it continues, becomes obscured in the rough topography. There is a bare possibility that it may bend southeastward and coincide with the overthrust fault at the Pendleton County Line but the cross-sections differ so materially that this does not seem probable.

Just west of the point where South Branch of Potomac crosses the Grant-Pendleton County Line and just east of the axis of the Blue Rock Syncline, there is a fault of considerable proportions, the origin and effects of which are highly problematical, the surface relationships being quite plain but the underground position of the rocks being subject to much doubt. As shown by Figure 8 there is an exposure of about 100 feet of the New Scotland Chert, or upper, member of the Helderberg Limestone just west of the fault, dipping eastward at an angle of 40 degrees, beneath which, farther west, lies the Oriskany Sandstone. Just east of the fault the Bloomsburg Red Shale rests against the New Scotland Chert, followed by the Niagara Limestone and Clinton Shale, the dip at the contact between these latter two series being 75 degrees southeastward. At the contact of the Clinton with the White Medina Sandstone, farther east, the dip is 65 degrees northwestward, corresponding to the general slope along the western flank of the Cave Mountain Anticline, the axis of which lies about one-half mile southeast of the fault-plane. A study of these conditions and of the outcrops farther west along the eastern flank of the great Wills Mountain Anticline leads to the belief that the lower portion of the Helderberg Limestone and the entire Bossardville and Rondout Limestones must have slid downward along a concave fault-surface and that these groups reappear below drainage along the axis of the syncline, as all of them, together with the succeeding lower groups down to and including the

White Medina, outcrop in regular order on the eastern flank of the Wills Mountain Anticline farther west. If this hypothesis be true it must follow that the curving fault-line extends downward not more than 1,000 to 1,500 feet, as the Bloomsburg Red Shale appears to retain its position without being broken. Such a condition might be caused by a lateral force acting northwestward from the Cave Mountain Anticline and causing the overturn of the Helderberg and Oriskany, together with another force, due to the great weight of superincumbent strata, acting downward along the axis of the Blue Rock Syncline and causing the limestones to slip downward along the fault-line.

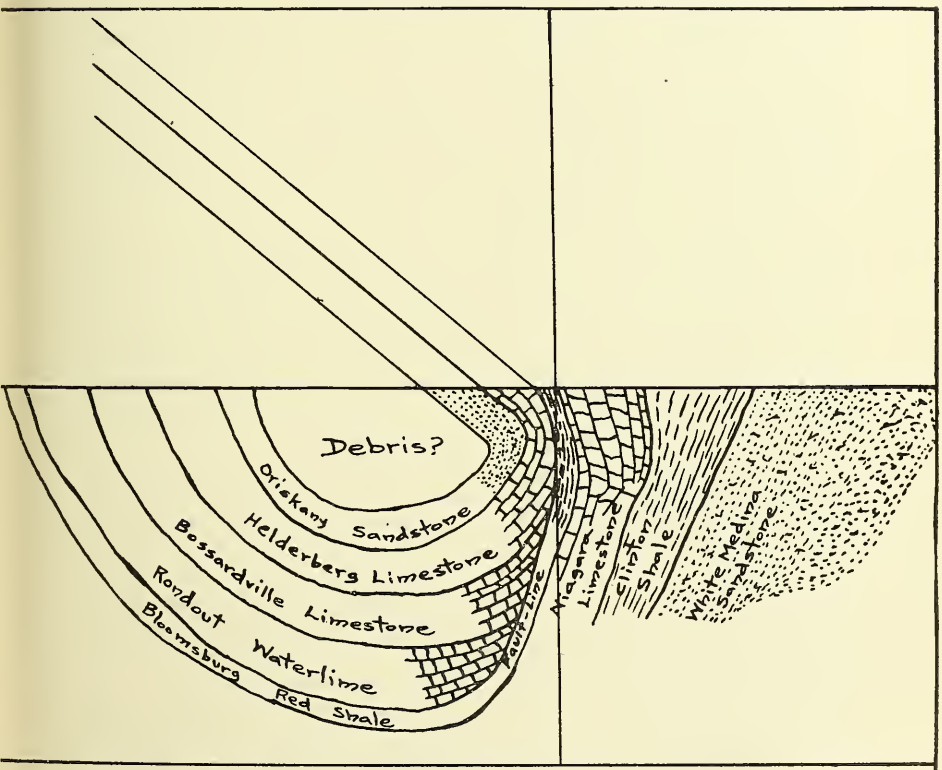

FIGURE 8.—Sketch showing hypothetical position of rocks below drainage at thrust-fault near point where South Branch of Potomac crosses Grant-Pendleton County Line. Horizontal line represents level of South Branch.

R.C.T.

CHAPTER V.

MEASURED SECTIONS.

INTRODUCTION.

The surface rocks of Mineral and Grant Counties embrace the Quaternary, with Recent and Pleistocene deposits, and a considerable portion of the Paleozoic, with Pennsylvanian, Mississippian, Devonian, Silurian, and Ordovician sediments. Of the latter period, only the Martinsburg Shale Series is represented above drainage. A classification of all the beds named, involving more than 18,200 feet of rocks, is published in Figure 5, on pages 85-87, inclusive.

The Quaternary Rocks are represented by clays, gravels, and sand beds, present along the river and creek bottoms, and by river terrace deposits of considerable quantity, some of which are of evident Pleistocene Age, although not of glacial origin. These two types of Recent material are represented on Maps II and IV under the general title of Alluvium. As agricultural soil they form a valuable economic resource of the two counties. The terrace deposits have been discussed at length on pages 33-40, inclusive.

The Dunkard Series of Permo-Carboniferous age, which is present in many of the western counties of the State and occupies a position just above the Monongahela Series of the Pennsylvanian, is not present in either county but remnants of it are reported in the Georges Creek Basin of Allegany County, Maryland, just north of Mineral County, and it seems entirely probable that it once covered a considerable portion of the region west of the Allegheny Front in both Mineral and Grant but has now been entirely removed by erosion.

The Monongahela Series of the Pennsylvanian, also, which probably once existed in the entire region west of the Allegheny Front and possibly extended still farther eastward, has now been largely eroded, there being only a few small fragments of it left along the North Potomac (Georges Creek) and Stony River Synclines, usually including less than 100 feet of rocks and never being more than 200 feet,

its full normal thickness in more western counties being about 375 to 400 feet.

The Conemaugh and Allegheny Series of the Pennsylvanian are both present in full thickness in the basins west of the Allegheny Front, the former having more than its normal development of more western counties while the latter is not so thick. The Pottsville Series also is present, being somewhat thicker than its counterpart in western Pennsylvania but representing only a small fraction of its great development in southwestern West Virginia where it is expanded by the introduction of new beds both within its limits as exhibited along the Potomac and also by additional members at lower depths.

The Mauch Chunk, Greenbrier, and Pocono of the Mississippian are all represented in Mineral and Grant but the former two are not nearly so thick as in more southern counties of the State.

The various groups of the Devonian are well displayed in the two counties, their maximum thickness approximating 11,000 feet and comprising more than half of the outcropping stratigraphic column. Only a few of the classical divisions of New York and eastern Pennsylvania are missing, the resemblance to the measures of these States being so close that little difficulty is encountered in making identifications. With the Devonian of Maryland, also, these rocks closely coincide, although the nomenclature is not in agreement.

The Silurian comprises 2,200 feet of sediments among which may be recognized nearly all of the more important groups of New York and Pennsylvania, no comparison with those of Maryland being possible because no comprehensive publication on the Silurian of that State has been issued.

The Ordovician rocks, represented only by the upper portion of the Martinsburg Shale, are of limited outcrop and in most cases almost entirely concealed by debris, but quite fortunately it was possible to make good collections of fossils from the latter group at one exposure on the crest of the great arch 7 miles west of Petersburg so that a comparison with the eastern and western phases has been obtained.

In the region west of the Allegheny Front numerous cross-sections, consisting of careful hand-level or aneroid measurements of surface beds, often combined with the records of coal test borings, and showing rock successions that range from the Monongahela to the Pottsville, have been made. In the region east of the Allegheny Front, where vertical measurement is not possible owing to the steep dips of the rocks, other sections have been made by horizontal measurement across the outcrops, reduced to approximately

vertical intervals by trigonometric methods. All of these various sections from the two regions appear in the following pages.

MEASURED SECTIONS, MINERAL COUNTY.

Mineral County includes portions of the comparatively flat-lying rocks of the Pennsylvanian west of the Allegheny Front and also a large area of the disturbed beds of the lower measures east of the mountain, its rocks ranging from the Monongahela Series of the Pennsylvanian down to the Red Medina of the Silurian.

MEASURED SECTIONS, FRANKFORT DISTRICT, MINERAL COUNTY.

Frankfort District occupies the extreme northern end of Mineral County, embracing a part of the North Branch of Potomac River drainage. Its surface rocks range from the Chemung Series of the Upper Devonian down to the White Medina Sandstone of the Silurian, all of which have been highly folded by the numerous anticlines that traverse it.

The following section, arranged in descending order, was measured with aneroid and clinometer, starting with the North Branch of Potomac River at Cedar Cliff and ascending the steep and almost perpendicular limestone bluffs to the top of Knobly Mountain one-third mile southeastward, reductions to approximately true vertical measurment having been made. Owing to the short horizontal distance involved it is believed that this section represents the most accurate measurement of the Devonian and Silurian Limestones obtained in either county, but it apparently does not quite reach the base of the Rondout Waterlime:

Cedar Cliff Section, Frankfort District.

	Thickness. Feet.	Total. Feet.
Oriskany Sandstone ( )		
1. Sandstone fragments, **Ridgeley**, brown, coarse, with **Spirifer**, capping point of Knobly Mountain	.....	.....
Helderberg Limestone (469')		
2. Concealed, with chert (**New Scotland**) and limestone	165	165
3. Limestone, hard, gray, partly flaggy and partly massive, cherty at top	158	323
4. Limestone, brecciated, numerous crinoids	146	469
Bossardville Limestone (463')		
5. Concealed, with limestone, to road (1110' B.)	224	693
6. Limestone, gray, flaggy	34	727
7. Limestone, hard, gray, massive	16	743
8. Limestone, gray, flaggy	23	766

	Thickness. Feet.	Total. Feet.
9. Limestone, gray, massive, fossiliferous	100	866
10. Limestone, gray, flaggy, to top of lower bluff	66	932
Rondout Waterlime (409')		
11. Limestone, hard, gray	269	1201
12. Limestone, gray, flaggy, "waterlime" weathers to irregular flaggy blocks (once mined by tunnel for use in cement plant) (710' B.)	16	1217
13. Limestone, cavernous, very shaly at base	105	1322
14. Concealed, to Potomac River (615' B.)	19	1341

The following section, arranged in descending order, was measured along the Baltimore and Ohio Railroad in the vicinity of Potomac Station, Allegany County, Maryland. It starts on the Cresaptown road just north of the station, the measures at this point being overturned and dipping abnormally toward the southeast. The contact of the Oriskany and Helderberg is obscured but a portion of the upper part of the latter is well exposed in the bluff just northeast of the station, the overturn at this point being of less degree but still perceptible. From the station eastward in the long cut of the railroad the measures assume a vertical position for several hundred feet and then gradually change to the northwestward dip that might be expected on the western flank of the Wills Mountain Anticline. In most of the cut the nearly vertical exposures afford ideal conditions for measuring the strata but in the basal portion of the Rondout Waterlime there is an evident duplication of the strata, as the same member has apparently been mined at two different points (Nos. 7 and 11 of section) for cement purposes, a previous discussion of the evidence on this point having been given on page 127. For this reason the thicknesses recorded must not be taken as representative of the Bossardville and Rondout but rather as the visible exposure in the cut. The duplication, however, does not seem to be large, as the combined Bossardville and Rondout are approximately the same as those recorded in the Cedar Cliff Section above. All exposures in the Potomac Section have been reduced as nearly as possible to true vertical measurement, those of the Clinton Shale being somewhat uncertain, as there is a concealed interval that is estimated at 200 feet:

Potomac Section, Allegany County, Maryland.

	Thickness. Feet.	Total. Feet.
Marcellus Shale ( )		
1. Shale, dark, fissile, **Marcellus**	.....	.....
Oriskany and Helderberg (550')		
2. Sandstone, partly concealed, weathered to yellow, cherty gravel, **Shriver Chert**	50+	50
3. Concealed, with chert	300	350
4. Limestone, gray, hard, with marine fossils (**Stromatopora** beds at base), **Helderberg**	200	550
Bossardville and Rondout (860')		
5. Limestone, partly concealed	150	700
6. Limestone, gray or yellowish, with streaks of shale	600	1300
7. Limestone, gray, shaly, ripple-marked (formerly mined for cement)	20	1320
8. Limestone, gray	30	1350
9. Shale, soft, yellow, ocherous	5	1355
10. Limestone, very shaly	15	1370
11. Limestone, gray, shaly, ripple-marked (formerly mined for cement)	20	1390
12. Limestone, gray, shaly	10	1400
13. Shale, gray, limy	10	1410
Bloomsburg Red Shale (68')		
14. Sandstone, brown	5	1415
15. Shale, soft, yellow, ocherous	5	1420
16. Sandstone, hard, greenish-brown	8	1428
17. Shale, yellow, fissile	50	1478
Niagara Limestone (100')		
18. Limestone, gray, flaggy, with numerous small brachiopods	100	1578
Clinton Group (655')		
19. Shale, brown	25	1603
20. Sandstone, brown	10	1613
21. Shale, gray, weathering brown	300	1913
22. Concealed, across ravine	200	2113
23. Shale, gray, weathering brown	100	2213
24. Sandstone, red, ferriferous, "**Iron Sandstone**"	20	2233
25. Shale, gray	.....	.....

The following section, arranged in descending order, starts at the Chemung-Portage contact, on Tanners Run of Patterson Creek, 1.5 miles southeast of Knobly, and extends northwestward along the public road to the Genesee-Hamilton contact, which is found 0.4 mile southeast of Knobly, and affords a very fair measurement of the Portage and Genesee, there being no concealed portions and no appreciable reversals of dip. Being on the direct rise of the strata with all conditions favorable it is believed that the thicknesses indicated in the section represent approximately true vertical measurement:

Knobly Section, Frankfort District.

	Thickness. Feet.	Total. Feet.
1. Sandstone, green, flaggy, fossiliferous, Chemung Series	.....	.....
Portage Series (1780')		
2. Shale and sandstone, greenish-gray	547	547
3. Shale, greenish-gray	296	843
4. Shale, greenish-gray	364	1207
5. Shale, greenish-gray, with thin sandstones	573	1780
Genesee Series (313')		
6. Shale, greenish-black, fissile, fossiliferous	313	2093
7. Shale, brown, fossiliferous, Hamilton Series	.....	.....

MEASURED SECTIONS, CABIN RUN DISTRICT, MINERAL COUNTY.

Cabin Run District, lying just south of Frankfort, embraces a portion of the Patterson Creek drainage between Knobly Mountain on the west and the northern extension of Patterson Creek Mountain on the east. Its surface rocks range from the Chemung Series, present along the Big Springs Run and Bedford Synclines, to the Helderberg Limestone, which is exposed along portions of Knobly Mountain. In this district no attempt to measure sections of much length proved successful, as the frequent overturns and reversals of dip preclude the possibility of even a fair approximation at most points.

MEASURED SECTIONS, WELTON DISTRICT, MINERAL COUNTY.

Welton District lies south of Cabin Run and embraces a further section of the Patterson Creek drainage between Knobly Mountain and Patterson Creek Mountain, its surface rocks ranging from the Chemung of the Upper Devonian down to the Bossardville of the Silurian. Opportunities for favorable measurements, especially in the Chemung and Portage, are few, as there are frequent reversals and overturns which interrupt the succession.

The following section, arranged in descending order, starts at the base of the Portage Series on the Northwestern Pike 0.4 mile southeast of Ridgeville and extends northwestward along this road to the base of Knobly Mountain 0.7 mile northwest of the village. The Genesee and Hamilton are not differentiated but other contacts are plain. The exposure of the Lower Selinsgrove Limestone, however, is complicated by some slight but rather perplexing reversals of dip and its thickness, as finally recorded in the section, is probably too great, but the succession exhibits the position of this member in the series:

Ridgeville Section, Welton District.

	Thickness. Feet.	Total. Feet.
1. Shale and sandstone, greenish-gray, Portage Series	.....	.....
Genesee and Hamilton Series (903')		
2. Shale, rusty-brown, sandy, fossiliferous	476	476
3. Shale, rusty-brown	427	903
Marcellus Series (573')		
4. Shale, black, fissile	327	1230
5. Limestone, dark, shaly, fossiliferous, Lower Selinsgrove	148	1378
6. Shale, black, fissile	98	1476
Oriskany Series ( )		
7. Sandstone, massive, yellowish-brown, fossiliferous, Ridgeley	.....	.....

MEASURED SECTIONS, NEW CREEK DISTRICT, MINERAL COUNTY.

New Creek District occupies the south central portion of Mineral County, extending from North Branch of Potomac River southwestward to the Grant County Line and from the summit of Allegheny Front southeastward to Knobly Mountain. Its surface rocks, ranging from the Pottsville Series of the Pennsylvanian down to the Red Medina of the Silurian, lie mainly but not entirely on the northwestern slope of the great Wills Mountain Anticline, from the axis of which there is a gradually decreasing dip toward the Allegheny Front. Frequent reversals and possibly overturns, as well as concealed intervals, in the shales of the Upper and Middle Devonian, introduce a large element of inaccuracy in any attempt to measure these strata, but in the Lower Devonian and Silurian, conditions are somewhat more favorable.

The following section, arranged in descending order, starts with the axis of the Noswad Syncline where it crosses North Branch of Potomac River about one-half mile east of Keyser and includes a traverse eastward at an angle oblique to the maximum rise, the exposures being principally obtained in or near the quarries of the Standard Lime and Stone Company which have laid bare some of the Devonian and Silurian limestones. All possible corrections to obtain true vertical thickness have been made, but, owing to the irregular and somewhat crescent-shaped faces of the quarries and to the frequent variation of dip, precision can not be claimed:

Limestone Run Section, New Creek District.

	Thickness. Feet.	Total. Feet.
Oriskany Sandstone (194')		
1. Sandstone, massive, yellowish-brown, fossiliferous, **Ridgeley Sandstone**	129	129
2. Sandstone, cherty, yellowish, **Shriver Chert**	65	194
Helderberg Limestone (356')		
3. Limestone, gray, cherty, hard, **New Scotland Chert**	66	260
4. Limestone, massive, dark-gray and fossiliferous, with triangular joint-planes (quarried)	187	447
5. Limestone, massive, fossiliferous, **Stromatopora** at base	103	550
Bossardville Limestone (234')		
6. Limestone, gray, flaggy, and shaly, rhomboidal joint-planes, (lower portion quarried)	234	784
Rondout Waterlime (292')		
7. Limestone, dark, flaggy, hard, surface has checkered "calico" weathered bands (quarried)	144	928
8. Concealed, with limestone, to low sag east of quarry	148	1076

A measurement and exhaustive discussion of the Helderberg Limestone has been made at the above point by members of the Maryland Geological Survey, and other measurements of the Oriskany and Helderberg have also been made along the Potomac by the same organization, some of which will be presented under the discussion of the Lower Devonian in Chapter XIII.

The following section, reduced to approximately vertical measurement and arranged in descending order, starts at the Pottsville-Mauch Chunk contact just west of Slaughterhouse Run of North Branch of Potomac, 0.8 mile southeast of Piedmont and traverses southeastward along the public highway to the western limits of Keyser and then follows in the same direction to Thunder Hill Run, one-half mile northwestward from the Potomac State School. Exposures and dips are poor in the Mauch Chunk, Greenbrier, and Pocono, reasonably good in the Catskill, very good in the upper 1,237 feet of the Chemung, extremely poor in the lower 2,810 feet of the Chemung, and also poor in that portion of the Portage represented in the section except in the bluff just west of Thunder Hill Run. It was found impossible to continue the section on down to the Oriskany Sandstone due to reversals of dip in strata that are only slightly exposed. The Chemung-Portage contact is somewhat indistinct but is based on the sudden disappearance of marine fossils in the debris that litters the slope a few hundred feet west of Thunder Hill Run. Compared with other sections the thicknesses of both

the Greenbrier and Chemung seem excessive and it may be that the few dips observed in the former and in the last two items of the latter are above the average of the strata to which they are applied in computation:

Keyser Section, Piedmont and New Creek Districts.

	Thickness. Feet.	Total. Feet.
Mauch Chuck Series (827′)		
1. Shale, red, mostly concealed	322	322
2. Sandstone, mostly, with beds of shale	85	407
3. Concealed, with reds, to Powder House Run	109	516
4. Red shale and flaggy sandstone, mostly concealed	311	827
Greenbrier Series (273′)		
5. Limestone, partly concealed	273	1100
Pocono Series (596′)		
6. Concealed	239	1339
7. Sandstone, massive	30	1369
8. Concealed, and gray and red shale	287	1656
9. Sandstone, massive, **Berea?**	40	1696
Catskill Series (1925′)		
10. Wash and red soil, to ravine	82	1778
11. Concealed, with red soil and flaggy sandstone, to ravine	460	2238
12. Concealed, shaly sandstone, and red shale, to ravine	1014	3252
13. Red shale and shaly sandstone, alternating, to point just west of railroad tower	369	3621
Chemung Series (4047′)		
14. Sandstone, yellowish-brown, shaly, with marine fossils (**Spirifer, etc.**), **Hendricks (?)**	20	3641
15. Sandstone, green, flaggy, laminated with reddish-green shale, and occasional ripple-marks	188	3829
16. Sandstone, green, with oblong, flattened, quartz pebbles	4	3833
17. Sandstone, green, flaggy, laminated, with reddish-green streaks of shale and occasional bands of marine fossils (**Crinoids,** etc.)	374	4207
18. Shale, green, with occasional streaks of red, and with flaggy, ripple-marked sandstones	495	4702
19. Sandstone, green, fine-grained, with thin streaks of conglomerate	20	4722
20. Shale, green	10	4732
21. Sandstone	15	4747
22. Shale, green, with streaks of red near top, and thin sandstone beds	111	4858
23. Concealed, (yellow soil), to ravine at west edge of Keyser	1225	6083
24. Concealed with flaggy, fossiliferous, green sandstone	1585	7668
Portage Series (689′)		
25. Greenish-gray shale and sandstone, to Thunder Hill Run	689	8357

The ground covered by the above section was long ago traversed by Dr. I. C. White, who with the assistance of his class of students in geology at the West Virginia University measured a long section starting with the Monongahela Series of the Pennsylvanian in the top of Westernport (Franklin) Hill about 1½ miles northwest of Westernport, Maryland, and extending to the base of the Pottsville Series just east of Piedmont, and then continuing southeastward through the gap of the Potomac between Dans Mountain and Allegheny Front to Keyser, and thence southeastward to Walkers (now known as Abrams) Ridge where the Wills Mountain Anticline brings the White Medina Sandstone to the surface. The section as measured was published in the Proceedings of the American Philosophical Society, Volume XIX, No. 109, pages 438-446, June to December, 1881, and is described by the author as "A rectification of the Section made by Mr. Howard Grant Jones, M. S., and published under the title of 'Notes on the Cumberland or Potomac Coal Basin' in Proc. A. P. S., No. 107, pages 111-116."

Besides being one of the first authentic attempts to measure the rocks of this locality in detail and well worth reproduction for that reason alone, the section contains several important details which are either now obscured or which escaped the attention of the writer during his work in this region, among which are a full section of the Pittsburgh Coal, which at present is not fully exposed to view at any point along the North Potomac, and the presence of a marine annelid in the upper portion of the White Medina Sandstone. With the permission of Dr. White the names of coals and other members of the Pennsylvanian have been revised to make them harmonize with the numerous changes in nomenclature made necessary by the investigations of recent years, and in the Devonian and Silurian, also, headings have been introduced to indicate the relationship of the various members to the usage employed in this volume. The section as thus amended is as follows:

North Potomac Section, in Allegany County, Maryland, and Piedmont and New Creek Districts, Mineral County, West Virginia, by Dr. I. C. White.

	Thickness Ft.	In.	Total Ft.	In.	Interval Ft.	In.
Monongahela Series (266′ 8″)						
1. Massive sandstone, coarse, grayish-white, most probably equivalent to one often found in Greene County, Pennsylvania, 100 feet below the Waynesburg Coal. It caps the summit of Westernport Hill	25	0	25	0		
2. Mostly concealed, but showing some outcrops of flaggy sandstone and shale	130	0	155	0		
3. **Coal blossom, large, Sewickley**	....	....	155	0	155	0
4. Concealed	90	0	245	0		
5. Shale, grayish	2	0	247	0		
6. **Pittsburgh Coal (19′ 8¼″) at Franklin Company's new opening Westernport Hill**: **Coal**, impure ....0′ 8″; Dark slate 4′ 0″; **Coal**, slaty .....1′ 0″; Shale, grayish ....1′ 0″ — Roof coal .....6′ 8″; **Coal**, main bench, no partings, all good ....10 0; Slate .....0′ 2″; **Coal**, good .....0′ 10″; Parting .....0′ 0¼″; **Coal**, not mined .....2 0″ — Bottom coal 3 0¼	19	8	266	8	111	8
Conemaugh Series (817′ 8″)						
7. Dark slate	0	6	267	2		
8. Soft, carbonaceous shale	0	2	267	4		
9. Shales, drab	15	0	282	4		
10. Sandstone, flaggy and shaly	25	0	307	4		
11. Concealed	140	0	447	4		
12. **Coal blossom, Little Clarksburg ("Franklin," "Dirty-Nine-foot")**	....	....	447	4	180	8
13. Concealed	100	0	547	4		
14. **Coal blossom**	....	....	547	4		
15. Concealed	140	0	687	4		
16. **Coal, Elk Lick ("Barton," "Four-foot")**	4	0	691	4	244	0
17. Concealed	35	0	726	4		
18. Sandstone, massive, pebbly, Grafton	30	0	756	4		
19. Concealed, with a coal (probably Harlem) reported 4 feet thick just below top						

	Thickness. Ft.	In.	Total. Ft.	In.	Interval. Ft.	In.
of the interval	90	0	846	4		
20. Sandstone, massive, visible, **Saltsburg**	20	0	866	4		
21. Concealed	10	0	876	4		
22. **Coal, Upper Bakerstown,** Spangler's opening, Westernport Hill:						
Coal 2′ 0″ Shale, gray 1 0 **Coal** 2 0	5	0	881	4	190	0
23. Concealed	10	0	891	4		
24. Shale, bluish	10	0	901	4		
25. **Coal, Bakerstown ("Thomas")**	2	6	903	10	22	6
26. Fire clay	2	0	905	10		
27. Concealed	10	0	915	10		
28. Sandstone, very hard	2	0	917	10		
29. Sandstone, shaly	5	0	922	10		
30. Shales, sandstone **(Buffalo),** and concealed	55	0	977	10		
31. Dark, bituminous shales, **Brush Creek (marine fossils** found at this horizon by D. B. Reger)	5	0	982	10		
32. **Coal, Brush Creek,** visible	2	0	984	10	81	0
33. Dark shales and concealed	10	0	994	10		
34. Sandstone, very massive, **Upper Mahoning**	50	0	1044	10		
35. Shales, drab, 0′ to	5	0	1049	10		
36. **Coal, Mahoning ("Six-foot")** (5′ 6½″) Spangler's opening, in Westernport Hill:						
Coal, Slaty 1′ 0″ **Bony coal** 0 8 **Coal,** pyritous 1 4 Slate, hard 0 0½ **Coal,** best 2 6	5	6	1055	4	70	6
37. Fire clay, very sandy	3	0	1058	4		
38. Shales, with nodular iron ore	2	0	1060	4		
39. Fire clay, impure	4	0	1064	4		
40. Flaggy sandstone, **Lower Mahoning**	20	0	1084	4		
Allegheny Series (127′ 0″)						
41. Concealed (contains **Upper Freeport, "Split-six," "Davis" Coal,** 2 to 3 feet thick, D. B. R.)	25	0	1109	4		
42. Fire clay, very sandy and impure, **Bolivar**	10	0	1119	4		
43. Flaggy sandstone	10	0	1129	4		
44. Sandy shales	15	0	1144	4		
45. Massive sandstone, **Lower Freeport**	20	0	1164	4		
46. **Coal, Upper Kittanning**	2	0	1166	4	111	0

	Thickness.		Total.		Interval.	
	Ft.	In.	Ft.	In.	Ft.	In.
47. Dark shales, containing many fossil plants, **Pecopteris dentata, P. polymorpha, Neuropteris flexuosa, N. acutifolia, Odontopteris** sp.?, and many other common **Coal Measure** forms; also many nodules of "Kidney" **iron ore** (Johnstown and Vanport, D. B. R.), all seen in cutting at Davis Bridge (Saw Mill road) opposite Piedmont	45	0	1211	4		
Pottsville Series, No. XII, (402′ 0″)						
48. Sandstone, hard, **Homewood,** somewhat current-bedded, inclined to be flaggy, weathering in holes, seen in cliff to level of North Potomac, at Piedmont, just above the Cumberland & Pennsylvania Railroad bridge	40	0	1251	4		
49. Dark shales (coaly) and concealed	30	0	1281	4		
50. Sandstone, flaggy, portion of **Homewood**	10	0	1291	4		
51. Shale, dark, olive	2	0	1293	4		
52. **Coal, Tionesta**	1	6	1294	10	128	6
53. Fire clay, dark, sandy, **Mt. Savage**	12	0	1306	10		
54. Sandstone, flaggy, with **coal streaks**	10	0	1316	10		
55. **Coal, Upper Mercer**	1	6	1318	4	23	6
56. Shale, with nodular **iron ore**	2	0	1320	4		
57. Shales and flaggy sandstone	40	0	1360	4		
58. Massive, very hard, grayish-white, fine-grained sandstone, with some small pebbles, **Upper Connoquenessing.** Seen forming a long line of cliffs on the Maryland side of the Potomac, 1 mile below Piedmont, and also capping the summit of the Front Ridge Allegheny on the West Virginia side, 2 miles below Piedmont	45	0	1405	4		
59. **Coal shale, Quakertown Black Shale** and **Quakertown Coal, (Naiadites elongata** Dawson found in the shale by D. B. R.)	5	0	1410	4	92	0
60. Concealed, with some shale and flaggy sandstone visible	145	0	1555	4		
61. Sandstone, massive	10	0	1565	4		
62. Bituminous shale	10	0	1575	4		
63. Sandstone, flaggy	10	0	1585	4		

	Thickness.		Total.		Interval.	
	Ft.	In.	Ft.	In.	Ft.	In.
64. Sandstone, massive, whitish	20	0	1605	4		
65. **Coal, Sewell (Sharon?)**, seen at roadside along the Maryland shore of North Potomac, 1 mile below Piedmont	1	0	1606	4	196	0
66. Sandstone, drab	4	0	1610	4		
67. Fire clay and shale	3	0	1613	4		
Mauch Chunk Series, No. XI, (844′ 0″)						
68. Sandy shale	4	0	1617	4		
69. Shales, brown, containing iron ore	10	0	1627	4		
70. **Red shale**	10	0	1637	4		
71. Sandstone, flaggy, greenish-gray, with much shale	40	0	1677	4		
72. Concealed	40	0	1717	4		
73. Sandstone, somewhat massive, greenish-gray	20	0	1737	4		
74. Concealed, but showing occasional appearance of **red shale**, and very probably largely composed of that material	375	0	2112	4		
75. Sandstone, somewhat massive, but often inclined to be flaggy, greenish-gray; seen in cliffs along the Baltimore & Ohio Railroad cuts, near the 205th mile-post from Baltimore below Piedmont	130	0	2242	4		
76. **Red shales**	35	0	2277	4		
77. Shales, greenish, sandy	20	0	2297	4		
78. **Red shale**, to level of Baltimore & Ohio Railroad track at little run 76 rods east from the 205th mile-post from Baltimore	10	0	2307	4		
79. Concealed	150	0	2457	4		
Greenbrier Series, No. XI, (340′ 0″)						
80. Limestone, gray, fossiliferous, containing **Spirifer keokuk, Athyris subquadrata, Productus cora, Hemipronites crassus,** and many **Crinoidal fragments**	10	0	2467	4		
81. Concealed, but probably containing several layers of limestone	90	0	2557	4		
82. Limestone, gray, massive	5	0	2562	4		
83. **Red shales** and concealed	140	0	2702	4		
84. Sandstone, coarse, brownish, visible	5	0	2707	4		
85. Concealed	50	0	2757	4		
86. Limestone, grayish-white, no fossils seen	10	0	2767	4		
87. Siliceous limestone (of Stevenson in Fayette and West-						

	Thickness. Ft.	In.	Total. Ft.	In.	Interval. Ft.	In.
moreland Counties, Pennsylvania) exhibiting a wavy or current-bedded structure and giving forth a metallic resonance when struck with a hammer	30	0	2797	4		
Pocono Series, No. X, (1150′ 0″)						
88. Gray, current-bedded, mostly flaggy sandstones, no conglomerates seen, nor red shales; rising at an angle of 18° to 20° towards the southeast, and extending along the Baltimore & Ohio Railroad for 58 chains, the lowest layers rising above railroad level 33 chains east from the 204th Baltimore mile-post; thickness about	1150	0	3947	4		
Catskill Series, No. IX, (1300′ 0″)						
89. Dark red shales alternating with red, and greenish-gray sandstones, containing **fish remains**, but no molluscans seen; rising towards the southeast at an angle of 25° at top and 35° where the bottom layers come up 7 chains west of 203rd mile-post, thus making a vertical thickness of, say	1300	0	5247	4		
Chemung Series, in part, No. VIII, (1342′ 0″)						
90. Alternate layers of thin, olive sandstones, and shales, very fossiliferous, and perfectly exposed along the Baltimore & Ohio Railroad in vicinity of 203rd mile-post; coming up towards the southeast at an angle of 35°, and at the end of 10½ chains the dip is increased to 45° thus giving an approximate thickness of Chemung down to this point of about	400	0	5647	4		
91. **Conglomerate**, composed of very thin, flat, rounded quartz pebbles, in a matrix of coarse rotten sand with numerous fossil shells imbedded, very forcibly reminding one of the Venango Lower (3rd) Oil Sand; thickness	2	0	5649	4		
92. Flaggy sandstones and shales						

	Thickness. Ft.	In.	Total. Ft.	In.	Interval. Ft.	In.
continue rising at an angle of 45° for 16 rods farther towards the southeast all perfectly exposed, and very fossiliferous; thickness about	200	0	5849	4		
93. Concealed, 13½ chains, at the end of which the strata are rising at an angle of 62° towards the southeast thus making the intervening rock thickness about	700	0	6549	4		
94. **Conglomerate,** a gray, hard sandstone, containing numerous layers filled with flattish, white quartz pebbles	40	0	6589	4		
Chemung (remainder of), Portage, Genesee, Hamilton, and Marcellus (6000′ 0″)						
95. As we go southeast from this point toward Keyser, the rocks rapidly increase their dip to the northwest, and at ½ mile from the outcrop of No. 94 are vertical; continuing thus or even slightly bent over beyond the perpendicular to the end of 100 chains (1¼ miles) from No. 94 exposures are rare in this interval, as there are seldom more than 5 to 10 feet exposed at any one locality, and these are in every case olive- and drab-colored shales. The topography also shows that no hard nor massive rocks occur in this interval, since on entering it the mountain immediately breaks down to the southeast giving a broad valley along the Potomac, bordered by gently sloping hillocks. The interval includes all the rest of No. VIII (Chemung), whatever there may be of **Portage, Hamilton,** and **Marcellus** and its thickness can not be less than	6000	0	12589	4		
Oriskany Sandstone, No. VII (75′)						
96. This rises above the North Potomac nearly opposite the depot at Keyser, and arching up over New Creek Ridge						

	Thickness. Ft.	In.	Total. Ft.	In.	Interval. Ft.	In.
(Mountain) forms the bold cliff at Queen's Point, opposite Keyser, 400 feet almost vertically above the river; a very coarse, brownish sandstone filled with its characteristic fossils, **Spirifer arenosus, Rensselaeria ovoides,** and **Platyceras ventricosum;** it comes down to the river at the railroad cut a short distance east from Keyser, with a strong southeast dip, but immediately returning it comes up again with a strong northwest dip (65°), and arching up passes in the air over the next anticline to come down again along the (monoclinal) crest of Knobly Mountain; thickness	75	0	12664	4		
Helderberg, Bossardville, and Rondout Limestones, No. VI, (1050′) 97. At top a gray, siliceous limestone, with several layers of flint 6 to 10 inches thick, interstratified for about 150 feet, then follow blue and gray layers of pure limestone richly fossiliferous, **Strophomena radiata, S. rugosa, Pentamerus pseudogaleatus, Rynchonella ventricosa, Spirifer macropleurus, Atrypa reticularis, Tentaculites ornatus, Leperditia alta,** besides numerous species of **Favosites, Zaphrentis, Stromatopora,** and **Chaetetes,** being very abundant. Very fine **Trilobites** are also reported from some of the quarries, which, from their (reported) size, must be a species of **Asaphus.** This is the limestone which was identified in H. G. Jones's section as the **Lower Mountain Limestone** of XI, and 440 feet thick. My measurements make it much thicker, however; it is finely exposed along Limestone Run one-half mile southeast from Keyser; it makes the							

	Thickness. Ft.	In.	Total. Ft.	In.	Interval. Ft.	In.
northwest slope of Knobly Mountain all the way between Keyser and Cumberland, the upper siliceous layers often forming the irregular crest of the same; its uppermost 300 feet are also exposed under the great arch of Oriskany Sandstone at Queen's Point opposite Keyser, where the North Potomac cuts through New Creek Mountain. The fossils given were all seen in the upper portion of the formation. No attempt was made to subdivide the series, which consists of limestone throughout, the measurement of which southeastward along Limestone Run gave the horizontal distance through it 18 chains, with a northwest dip of 63°, which would give a thickness of	1050	0	13714	4		
Bloomsburg Red Shale, Niagara Limestone, and Clinton Shale (730′ 0″)						
98. A succession of shales, marls, and thin, shaly limestones, with occasional brown, flaggy sandstones; near the center of which occur very strong **salt springs** from which considerable salt was formerly manufactured, the whole representing the lower portion of the **Salina group** of New York; thickness about	350	0	14064	4		
99. (a) Hard, gray, flaggy sandstone	20	0	14084	4		
(b) A succession of brownish, sandy shales with a few thin layers of impure limestone near the center (Niagara Limestone, D. B. R.) and two layers of **iron ore,** (Clinton Fossil Ore) the one 6 inches and the other 12 inches thick, and separated by 10 feet of shales, 50 feet below the center; thickness about	300	0	14384	4		
(c) The main mass of the Clinton "Iron Sandstone"						

	Thickness. Ft.	In.	Total. Ft.	In.	Interval. Ft.	In.
of Pennsylvania, 20 feet thick, quite rich in iron, but entirely too siliceous; once shipped from the land of Mr. N. Alcaire, on Limestone Run, by Uniontown, Pennsylvania, parties to Lemont Furnace and one or two in Pittsburgh, but after a thorough trial condemned by them all as too siliceous	20	0	14404	4		
(d) Shales	40	0	14444	4		
This whole group (a, b, c, d) and probably a portion of the overlying 350 feet in No. 98, representing whatever there may be of **Niagara** (if any) and all of the **Clinton (No. V).**						
White Medina, No. IV in part, (275′ 0″)						
100. Seen forming the lowest rocks in the ridge (anticlinal) half-way between New Creek Mountain and Knobly range, the upper portion reddish-brown to gray, iron-stained sandstone, containing **Arthrophycus harlani** in great numbers, thickness 150 feet; the lower portion an almost snow-white, very hard, fine-grained sandstone, some portions slightly streaked with iron, thickness 125 feet; finely exposed on Limestone Run one mile above its mouth where that stream cuts through the Walker's Ridge axis. This is the stratum which Mr. H. G. Jones identified as the Pocono, or white sandstone of X, the 100-foot sandstone with which his section ends (see Proc. A. P. S. Vol. XIX, No. 107, page 116). Thickness ..	275	0	14719	4		

An interesting comparison of the intervals obtained by Dr. White in the above section is afforded from the Piedmont, Westernport, Keyser, Ridgeville, Limestone Run, Knobly and other sections of the writer, published elsewhere in this

Chapter. In the Piedmont Section the thickness of the Conemaugh Series is found to be 818′ while that of Dr. White is 817′ 8.″ In the Piedmont Section the thickness of the Allegheny is recorded as 182′ and in the Luke Section on the opposite side of the Potomac it is 148,′ that of Dr. White being 127′ which is probably accounted for by the rising strata measured by him near the mouth of Georges Creek. In the Westernport Section a thickness of 383′ was found for the Pottsville, as compared to 402′ by Dr. White. In the Keyser Section thicknesses of 827′ and 273′ are recorded for the Mauch Chunk and Greenbrier, respectively, the intervals for the same two groups by Dr. White being 844′ and 340′. Both of these groups are poorly exposed in the gap, but the figures for the Mauch Chunk are in harmony while it is probable that an average of the two measurements of the Greenbrier would not be far from the truth.

In the Pocono and Catskill the Keyser Section shows thicknesses of 596′ and 1,925′, respectively, while Dr. White records 1,150′ and 1,300′. The sum of the two in the Keyser Section is 2,521′ and in that of Dr. White 2,450′, indicating no serious variance in the total. It is believed by the writer that the heavy highway cuts made in recent years have afforded a more accurate means of determining the contact between the two than was formerly available and this belief is reinforced by the fact that the Pocono is never more than 500 to 700 feet thick at any point in its long exposure along the eastern slope of the Allegheny Front in Mineral and Grant Counties south of the North Potomac, and at the same time a thickness of 2,417′ was found for the Catskill in the Claysville Section about 10 miles southwest of the Potomac, the contacts at top and bottom being very plain.

In the Chemung and other Devonian shales Dr. White makes no detailed measurement below the 1,342′ exposed along the railroad, but with this included estimates a total of 7,342′ from the top of the Chemung to the top of the Oriskany, while the Keyser (Chemung 4,047′), Ridgeville (Genesee, Hamilton, and Marcellus 1,476′), and Knobly (Portage 1,780′) Sections give 7,303′ as the thickness of the same groups, a coincidence that would appear remarkable. It is still believed, however, that the measurement of 4,047′ obtained for the Chemung in the Keyser Section is probably too large by 500′ or more, as other measurements or estimates in the Potomac Valley do not record a corresponding amount of strata.

In the Oriskany the Limestone Run Section gives a thickness of 194,′ including the Shriver Chert at its base, while Dr. White records only 75′ without reference to the chert

which is often 50′ or more in thickness. In the Helderberg, Bossardville, and Rondout Limestones the total of Dr. White is 1,050′, while the Limestone Run Section records 882′, the basal portion of the Rondout being concealed. At Cedar Cliff on the North Potomac a thickness of 1,341′ was obtained for these three groups and at Maysville, Grant County, 1,154′. An average of the four measurements probably approximates the truth.

In the Silurian rocks between the base of the Rondout and the top of the White Medina Dr. White makes no specific determination of the series contacts but gives a total of 730′ for the Bloomsburg, Niagara, and Clinton, as compared with 1,000′ in the Falls Section and 483′ at Maysville, indicating a considerable local variation in these groups.

The following section, arranged in descending order, starts at the Pocono-Catskill contact along the Northwestern Pike, 2.8 miles southwest of Claysville, and follows this road northeastward to the Genesee-Hamilton contact, and thence across the fields to the top of the Oriskany Sandstone on the Claysville-Laurel Dale road 0.7 mile south of the former village. Exposures in the Catskill and Chemung are very good and in the Portage they are fair, but in the Genesee, Hamilton, and Marcellus they are poor. Owing to the crooked alignment of the road, however, some of the same strata of the Chemung were crossed more than once in the line of traverse and the attempt to make proper allowance for these recurrences, together with the fact that this portion of the section was made on an extremely wide angle from the direction of maximum dip, may account for the apparent abbreviation of the total thickness of the Chemung. It seems probable, also, that the Chemung-Portage contact belongs farther down in the section than indicated, as the thickness of Portage appears slightly excessive. Marine fossils may ordinarily be found at this contact but none was observed along this portion of the road and the junction of the two series was taken somewhat arbitrarily at the base of a ten-foot stratum of conglomerate, which may be too high:

Claysville Section, New Creek District.

	Thickness. Feet.	Total. Feet.
1. Gray sandstones and shales, **Pocono Series**	.....	.....
Catskill Series (2417′)		
2. Shale, red, and sandstones, reddish-brown	390	390
3. Shale, red and sandstones, reddish	194	584
4. Shale, red, and sandstones, reddish-brown	176	760
5. Shale, red, and sandstones, reddish-brown	157	917
6. Shale, red, and sandstones, reddish-brown, mixed	338	1255

	Thickness. Feet.	Total. Feet.
7. Sandstones, gray and red, and red shale	430	1685
8. Shale, red, and sandstones, reddish	276	1961
9. Sandstones, reddish, and red shale	456	2417
Chemung Series (1424')		
10. Sandstone, greenish-brown, fossiliferous at top, Hendricks (?)	32	2449
11. Shale, greenish (with a few dark reds), and sandstones, flaggy	700	3149
12. Sandstones, flaggy, and brown shale (with a few reds)	682	3831
13. Sandstone, conglomeratic	10	3841
Portage Series (2058')		
14. Shale, greenish-gray, with thin sandstones	1541	5382
15. Shale, greenish-gray, with thin sandstones	517	5899
Genesee and Hamilton Series (720')		
16. Concealed	282	6181
17. Shale, brown, fossiliferous	438	6619
Marcellus Series (503')		
18. Shale, dark, fissile	448	7067
19. Limestone, dark, Lower Selinsgrove	5	7072
20. Shale, dark, fissile	50	7122
Oriskany Sandstone (50')		
21. Sandstone, yellowish-brown, fossiliferous, Ridgeley, at New Creek road	50	7172

MEASURED SECTIONS, PIEDMONT DISTRICT, MINERAL COUNTY.

Piedmont District embraces a small area lying principally west of the Allegheny Front and bordering on the North Branch of Potomac River and its surface rocks range from the Monongahela Series of the Pennsylvanian, the lower portion of which remains at some points along the axis of the North Potomac (Georges Creek) Syncline, down to the Mauch Chunk Series of the Mississippian, which outcrops in the gap of the Potomac east of Piedmont.

The following section, measured principally with hand-level, and arranged in descending order, and located on the Maryland side of the Potomac, starts on the brow of Horse Rock Hill, 0.7 mile east of the mouth of Georges Creek (Westernport), and descends to the base of the Pottsville Series which is found along the Western Maryland Railway about one mile southeast of the mouth of the creek, but does not represent a continuous line of traverse, as it was necessary to make disconnected measurements between definite stratigraphic horizons at two or three different localities on the hillside in order to keep on the strike of the rocks. It is probable that Nos. 24 and 26 of section represent the upper portion of the Upper Connoquenessing Sandstone, and the

top portion of this member may even be in the concealed interval above, as it is usually 100 to 150 feet thick in this region:

Westernport Section, Allegany County, Maryland.

	Tks. Ft.	Ttl. Ft.	Int. Ft.
Conemaugh Series (85′)			
1. Sandstone, massive, cliff, **Upper Mahoning**	30	30	
2. Shale, sandy and concealed	15	45	
3. **Coal, Mahoning,** ("Six-foot"), fallen shut, (Mine No. 265 on Map II)	.....	45	45
4. Shale, concealed, and sandstone, **Lower Mahoning**	40	85	
Allegheny Series (127′)			
5. Slate, dark, bony 3′ 0″	(4′ 9″) **Upper Freeport**		
6. **Coal,** soft 1 9	("Split-six" "Davis") (Mine No. 296 on Map II)	5	90	45
7. Shale and sandstone, **Upper Freeport**	10	100	
8. Shale, sandstone, and shale, partly concealed	65	165	
9. Sandstone, massive, cliff, **East Lynn**	34	199	
10. **Coal** 1′ 10″	(3′ 3″) **Lower Kittanning**		
11. Slate, black 0 1	(Mine No. 372 on Map II)	3	202	112
12. **Coal** 1 4			
13. Fire clay, flinty, **Lower Kittanning,** and shale	10	212	
Pottsville Series (383′)			
14. Concealed and sandstone 37	**Homewood**		
15. Concealed 17′	**Sandstone**		
16. Shale, sandy 22	**horizon**	76	288	
17. Slate, black, **coaly**	1	289	
18. Concealed	30½	319½	
19. Fire clay shale	2	321½	
20. **Coal, Tionesta,** (1′ 6″), (Exposure No. 391 on Map II)	1½	323	121
21. Fire clay, flinty, **Mt. Savage**	18	341	
22. **Coal,** soft, (2′ 2″), **Upper Mercer,** (Prospect No. 399 on Map II)	2	343	20
23. Concealed, with large amount of black, fissile shale	85	428	
24. Sandstone, massive	20	448	
25. Shale, sandy	5	453	
26. Sandstone, massive	8	461	
27. **Coal streak,** lenticular	.....	461	
28. Shale, black, fissile	6	467	
29. Sandstone, massive, great cliff, **Upper Connoquenessing,** 30′ to	50	517	
30. Shale, black, fissile, with **Naiadites** fossils, **Quakertown**	5½	522½	
31. **Coal,** (1′ 5″), **Quakertown,** (Exposure No. 402 on Map II)	1½	524	181
32. Sandstone	5	529	
33. Fire clay, impure	6	535	
34. Shale, sandy	30	565	
35. Sandstone, massive, **Sharon**	30	595	71
36. Red shale, top of **Mauch Chunk Series**	.....	.....	

The following section, measured principally with hand-level and arranged in descending order, starts on the west side of Montgomery Run of North Branch of Potomac River, 0.8 mile south of Hampshire, and extends northwestward along the strike of the rocks to the base of the Elk Lick Coal (No. 25 of section). Starting again with the base of the same coal at Mine No. 74 on Map II on the eastern side of Montgomery Run, it continues northeastward down the highway toward Piedmont and ends at the Potomac River just south of the highway bridge which connects the towns of Piedmont and Luke. Much care was taken to secure true vertical measurements between important coals and it is believed that nearly all dip has been eliminated except between the Elk Lick and Harlem Coals where it is probable that the true interval should be about 100 feet instead of 123 feet as measured along a slight dip. Such an interpretation would give the Conemaugh Series a thickness of 795 feet instead of 818 feet as indicated in the section. This section is regarded as the key to the correlations of the Conemaugh Series in the Upper Potomac Valley, as it exhibits the three principal marine fossiliferous horizons of the series, Ames Shale, Pine Creek Limestone, and Brush Creek Shale, in direct succession in the same hillside, as well as most of the important coals. A more extended discussion of the significance of the fossil zones and their bearing on the nomenclature of the coals will be found in Chapters VII and VIII. The same section has been previously described in the Tucker County Report of the Survey, pages 153-5, except that it did not include the Sewickley and Redstone Coals, which have been added in the present version:

Piedmont Section, Piedmont District.

	Tks. Ft.	Ttl. Ft.	Int. Ft.
Monongahela Series (115′)			
1. Sandstone, massive, **Sewickley**, and concealed, from top of ridge	30	30	
2. **Coal prospect**, fallen shut, **Sewickley ("Tyson")**, Silver Coal Company Mine **(No. 1 on Map II)**	.....	30	30
3. Concealed, sandy shale, and concealed	45	75	
4. **Coal blossom, Redstone**	.....	75	45
5. Shale, sandy	28	103	
6. **Coal mine**, fallen shut, **Pittsburgh**, (2037′ B.), Silver Coal Company No. 4 Mine **(No. 8 on Map II)**, reported	12	115	40
Conemaugh Series (818′)			
7. Concealed	19	134	
8. **Coal**, reported, **Morantown** (2018′ B.), Silver Coal Company Prospect **(No. 36 on Map II)**	.....	134	19
9. Concealed	134	268	

		Tks. Ft.	Ttl. Ft.	Int. Ft.
10. Wild coal, roof		.....	.....	
11. Coal ..... 2′ 0″	(7′ 3″) Little Clarksburg ("Dirty Nine - foot," "Franklin") (1877′ B.) Silver Coal Company Prospect (No. 45 on Map II); Section reported by Lewis Grant			
12. Rock 0 4				
13. Coal 0 2				
14. Rock 0 3		7	275	141
15. Coal 0 6				
16. Rock, 1′ 2″ to 2 0				
17. Coal 2 0				
18. Concealed		105	380	
19. Sandstone, massive, cliff, Morgantown		33	413	
20. Concealed		22	435	
21. Sandstone, shaly, Barton		28	463	
22. Shale, sandy		4	467	
23. Coal, slightly bony 1′ 5″	(4′ 10″) Elk Lick ("Four-foot," "Barton") (1680′ B.)			
24. Slate, bony 0 2				
25. Coal, soft 3 3	Silver Coal Company No. 3 Mine (No. 75 on Map II).	5	472	197
(Section continued, starting with Elk Lick Coal (1726′ B.) at Silver Coal Company No. 2 Mine (No. 74 on Map II) east of Montgomery Run:				
26. Concealed and shaly sandstone, Upper Grafton		80	552	
27. Coal blossom, Federal Hill, (1646′ B.), (Exposure No. 132 on Map II)		.....	552	80
28. Shale, sandy		11	563	
29. Sandstone, shaly, Grafton		5	568	
30. Shale, sandy, partly concealed		22	590	
31. Shale, green, sandy, with marine fossils, Ames		5	595	
31A. Coal blossom, "Harlem," (1603′ B.), (Exposure No. 144 on Map II)		.....	595	43
32. Concealed		5	600	
33. Sandstone, massive, partly concealed		20	620	
34. Concealed		36	656	
35. Shale, variegated, Pittsburgh Reds		10	666	
36. Sandstone, massive, Saltsburg		30	696	
37. Shale and concealed		5	701	
38. Coal blossom, Upper Bakerstown, (Exposure No. 166 on Map II), visible		2	703	108
39. Fire clay shale		17	720	
40. Concealed		33	753	
41. Coal blossom, Bakerstown ("Thomas"), (Exposure No. 184 on Map II)		.....	753	50
42. Fire clay and sandy shale		17	770	
43. Limestone, ferruginous and siliceous, with marine fossils, Pine Creek (Cambridge)		1	771	
44. Shale, dark, laminated		13	784	
45. Sandstone, massive, Buffalo		27	811	
46. Shale, dark, with marine fossils, Brush Creek		7	818	
47. Coal, (0′ 4″), Brush Creek, (1365′ B.), (Exposure No. 248 on Map II)		.....	818	65
48. Sandstone, shaly		5	823	
49. Shale, sandy		13	836	
50. Sandstone, shaly, ferriferous		10	846	
51. Fire clay shale, with ferriferous limestone,				

	Tks. Ft.	Ttl. Ft.	Int. Ft.
Brush Creek	5	851	
52. Sandstone, massive, **Upper Mahoning**	35	886	
53. Shale, dark	5	891	
54. **Coal** ....0′ 2″ 55. Slate, bony ....0 2 56. **Coal**, soft .....1 5 57. **Coal**, bony .....0 3 58. **Coal**, soft .....2 4 — (4′ 4″) **Mahoning ("Six-foot")** (1250′ B.) John Mullen Mine (**No. 259 on Map II**)	4	895	77
59. Fire clay and sandy shale	18	913	
60. Sandstone, massive, **Lower Mahoning**	10	923	
61. Fire clay shale, **Uffington**	10	933	
Allegheny Series (182′)			
62. Shale, dark, **Upper Freeport ("Split-six," "Davis") Coal horizon**	2	935	40
63. Fire clay shale, sandy	15	950	
64. Concealed	20	970	
65. Sandstone, massive, **Lower Freeport**	20	990	
66. Concealed	60	1050	
67. Sandstone, massive, **East Lynn**	30	1080	
68. Shale, sandy, partly concealed	25	1105	
69. **Coal blossom, Lower Kittanning**	.....	1105	170
70. Shale, sandy	10	1115	
Pottsville Series (95′)			
71. Sandstone, massive .....43′ 72. Shale, sandy ..... 2 73. Sandstone, cross-bedded, with shaly streaks .....30 — **Homewood**	75	1190	
74. **Coal, lenticular, Tionesta, 2½′ to**.....	0	1190	85
75. Fire clay shale, flinty, **Mt. Savage**	5	1195	
76. Concealed, to Potomac River just above highway bridge near pulp-mill	15	1210	

In the following section, arranged in descending order, Nos. 1-15 were measured with aneroid, starting with the Pittsburgh Coal in the top of Franklin Hill, 1.5 miles north of Luke, Maryland, in the edge of Garrett County, and extending southwestward and southeastward to the brow of the hill northeast of Luke. The other measurements, Nos. 16-67, were determined principally with hand-level, partly in the vicinity of Luke and partly in the hillside just west of the mouth of Georges Creek at Westernport, great care having been taken to tie the subordinate members to the coals of the Conemaugh and Allegheny Series which have been prospected and mined extensively in the locality. Owing to the slight southeastward rise of the rocks the thickness of the Conemaugh is probably about 50 feet less than true vertical measurement would show:

Luke Section, Allegany County, Maryland.

	Tks. Ft.	Ttl. Ft.	Int. Ft.
Monongahela Series (17')			
1. Shale, with streaks of coal	5	5	
2. Coal, slaty 1′ 3″			
3. Shale 1 6			
4. Coal 8 10 — (11′ 7″) Pittsburgh (1885′ B.) (Mine No. 6 on Map II)	12	17	17
Conemaugh Series (777')			
5. Shale and concealed in slope	109½	126½	
6. Coal, (0′ 6″), Little Clarksburg ("Franklin," "Dirty Nine-foot"), (1775′ B.) (No. 44 on Map II)	0½	127	110
7. Shale and concealed	30	157	
8. Sandstone, massive, brown, Lower Connellsville	20	177	
9. Concealed in slope	105	282	
10. Sulphur spring (1620′ B.)	.....	282	
11. Concealed and dark shale in slope	95½	377½	
12. Coal, medium-hard 1′ 2″			
13. Shale, dark 0 8			
14. Coal, soft 2 8 — (4′ 6″) Elk Lick ("Barton," "Fourfoot") (1520′ B.) Davis Coal & Coke Company Mine No. 72 on Map II).	4½	382	255
15. Shale and concealed	54	436	
16. Sandstone, massive, brown, partly concealed at top, Upper Grafton	22	458	
17. Concealed in steep bluff, with reds, Birmingham	40	498	
18. Sandstone, massive, gray, Grafton	8	506	
19. Concealed	12	518	
20. Shale, green, with fossil casts?, Ames	4	522	
21. Coal blossom, Harlem (1380′ B.)	.....	522	140
22. Concealed, with variegated shale, Pittsburgh Reds	38	560	
23. Sandstone, massive, gray, with streaks of iron peroxide, Saltsburg	31	591	
24. Shale, gray, sandy, laminated	6½	597½	
25. Coal, medium-soft 2′ 0″			
26. Shale, gray 0 8			
27. Coal, medium-soft 1 9 — (4′ 5″) Upper Bakerstown (1300′ B.) W. Va. Pulp and Paper Company Mine (No. 164 on Map II)	4½	602	80
28. Shale, dark, slickensided, with ferruginous layers	14½	616½	
29. Coal, bony 0′ 8″			
30. Coal, good 2 8 — (3′ 4″) Bakerstown ("Thomas") (1282′ B.) W. Va. Pulp & Paper Company Mine (No. 182 on Map II)	3½	620	18
31. Fire clay shale, yellowish-gray	5	625	
32. Concealed, with shale	10	635	
33. Sandstone	10	645	
34. Concealed, with fire clay shale	29	674	
35. Sandstone, shaly, Buffalo	10	684	
36. Shale, dark, with marine fossils, Brush Creek	15	699	
37. Coal, (0′ 9″), Brush Creek	1	700	80
38. Concealed	32	732	
39. Sandstone, massive, coarse, Upper Mahoning	30	762	

	Tks. Ft.	Ttl. Ft.	Int. Ft.
40. Shale, dark	2	764	
41. Coal, medium-hard 0′ 8″ 42. Coal, medium-soft 1 8 43. Slate, bony 0 2 44. Coal, soft, columnar 2 3 (4′ 9″) Mahoning ("Six-foot") (1133′ B.) W. Va. Pulp & Paper Company Mine (No. 269 on Map II)	5	769	69
45. Concealed and sandstone, Lower Mahoning	17	786	
46. Shale, sandy, dark, Uffington	8	794	
Allegheny Series (148′)			
47. Coal, Upper Freeport, W. Va. Pulp & Paper Company Mine (No. 298 on Map II), visible	2	796	27
48. Concealed	48½	844½	
49. Sandstone, massive, cliff rock, Lower Freeport	38	882½	
50. Coal, (2′ 0″ to 2′ 5″), Upper Kittanning, W. Va. Pulp & Paper Company Exposure (No. 354 on Map II)	2½	885	89
51. Slate, black	1	886	
52. Fire clay shale	5	891	
53. Limestone and shale, ferriferous, Johnstown Limestone	3	894	
54. Shale and concealed	5	899	
55. Sandstone, massive, East Lynn	30	929	
56. Draw slate, 0″ to 0′ 6″	0½	929½	
57. Coal, soft 1′ 5″ 58. Slate, dark 0 1 59. Coal, soft 1 1 (2′ 7″) Lower Kittanning (977′ B.) W. Va. Pulp & Paper Company Mine (No. 373 on Map II)	2½	932	47
60. Fire clay shale, with ferriferous limestone, Vanport	10	942	
Pottsville Series (65′)			
61. Sandstone, massive 23′ 0″ 62. Shale, gray 1 10 63. Coal, streak 0 2 64. Sandstone, massive 15 0 Homewood	40	982	
65. Shale, dark, with plant fossils, horizon of Tionesta Coal	2	984	52
66. Fire clay, flinty, with ferruginous nodules, Mt. Savage	8	992	
67. Concealed, to mouth of Georges Creek at Westernport	15	1007	

In the following section, arranged in descending order, Nos. 1-31 were measured with hand-level and the remaining portion with aneroid, starting in Garrett County, Maryland, at the top of the ridge 1.2 miles west of Bloomington and descending eastward down Bear Hollow to Savage River. Owing to many concealed intervals the exposures of the Conemaugh and Allegheny Coals are not as good as might have been expected in this steep ravine:

Bloomington Section, Garrett County, Maryland.

	Tks. Ft.	Ttl. Ft.	Int. Ft.
Conemaugh Series (559½′)			
1. Concealed, from top of ridge	50	50	
2. Sandstone, massive, **Morgantown**	20	70	
3. Concealed	46	116	
4. Shale, dark	10	126	
5. **Coal**, bony 0′ 9″ 6. **Coal**, medium-soft 3 0	4	130	130
(3′ 9″) **Elk Lick** (**"Four-foot," "Barton")** (1625′ B.) (**Mine No. 73 on Map II**)			
7. Concealed	20	150	
8. Sandstone, shaly, **Upper Grafton**	18	168	
9. Concealed	60	228	
10. Sandstone, **Grafton**, visible	2	230	
11. Concealed	65	295	
12. Sandstone, massive, **Saltsburg**	35	330	
13. Concealed and sandstone, shaly	25	355	
14. Concealed	10	365	
15. **Coal prospect**, fallen shut, **Bakerstown ("Thomas")** (1390′ B.), **(No. 183 on Map II)**	....	365	235
16. Shale, sandy and ferriferous, partly concealed, **Pine Creek Limestone horizon**	35	400	
17. Sandstone, massive at base, **Buffalo**	45	445	
18. Shale, dark, **Brush Creek**	10	455	
19. Slate, dark, **coaly, Brush Creek Coal** (1300′ B.)	....	455	90
20. Sandstone, shaly, and shale, sandy	34	489	
21. Sandstone, massive, cliff, **Upper Mahoning**	30	519	
22. Shale, dark, **coaly, Mahoning ("Six-foot") Coal** (1235′ B.)	1	520	65
23. Fire clay shale, **Thornton**	12	532	
24. Sandstone, shaly, **Lower Mahoning**	23	555	
25. Shale, sandy, **Uffington**	4½	559½	
Allegheny Series (120½′)			
26. **Coal**, soft 2′ 1″ 27. Shale, gray 0 11 28. **Coal**, soft 0 9 29. Shale, dark, bony 0 9 30. **Coal**, soft 0 11	5½	565	45
(5′ 5″) **Upper Freeport, ("Split-six," "Davis")** (1190′ B.) Baltimore & Ohio Railroad Exposure (**No. 300 on Map II**)			
31. Concealed, to Baltimore & Ohio Railroad	10	575	
32. Fire clay shale, with limestone, **Upper Freeport Limestone**	10	585	
33. Sandstone, massive, cliff, **Upper Freeport**	30	615	
34. Concealed, to Savage River	65	680	

In the following section, arranged in descending order, Nos. 1-10 were measured with hand-level at the old Everette Tunnel, which is now an open cut, along the Baltimore and Ohio Railroad 2.3 miles northwest of Bloomington, Maryland, Nos. 11-40 being exposures along the railroad northwestward for a distance of one mile or more to the point where the red shales of the Mauch Chunk Series appear at grade about one-fourth mile east of Bond Station. In this locality the rocks are rising rapidly northwestward toward Backbone

Photo by E. E. HARRIS.

PLATE VII.—View fromPinnacle Triangulation Point looking northeast across valley of New Creek. On left is escarpment of Allegheny Front and Dans Mountain, with successive Pocono and Catskill escarpments on lower slope. City of Keyser in right center, to the right of which is the low northern end of New Creek Mountain followed by Knobly Mountain in rear.

Mountain while the railroad grade descends in the opposite direction toward Piedmont, the Allegheny and Pottsville Series being very well exposed in the heavy cuts. Intervals in the Pottsville portion of the section, however, are little more than an approximation as it was not possible to secure reliable dip measurements, owing to the irregular bedding-planes of most of the sandstone members. The section reveals not only the Tionesta, Quakertown, and Sewell (Sharon?) Coal horizons but also the highly probable continuation of the Lower Gilbert, Nuttall, and Guyandot Sandstones which have now been traced almost continuously across the State northeastward from Tug Fork of Big Sandy River at the Kentucky Line into Maryland. A further discussion of this interesting feature of the Pottsville will appear in Chapter IX:

Bond Section, Garrett County, Maryland.

	Tks. Ft.	Ttl. Ft.	Int. Ft.
Allegheny Series (171')			
1. Shale, sandy	40	40	
2. Sandstone, massive, **Lower Freeport**	10	50	
3. **Coal, (1' 0") Upper Kittanning** (Baltimore & Ohio Railroad Exposure) **(No. 356 on Map II)**	1	51	51
4. Shale, sandy, with ferriferous limestone, **Johnstown**	22	73	
5. Sandstone, massive, **East Lynn**	15½	88½	
6. **Coal** 1' 4" / 7. Slate, dark 0 2 / 8. **Coal** 1 0 — (2' 6") **Lower Kittanning** (1310' B.) Baltimore & Ohio Railroad Exposure **(No. 377 on Map II).**	2½	91	40
9. Fire clay, **Lower Kittanning,** and sandy shale	13	104	
10. Sandstone, massive, **Kittanning**	17	121	
11. Concealed	50	171	
Pottsville Series (459')			
12. Sandstone, cliff, with streaks of shale 30' 0" / 13. **Coal** 1 4 / 14. Fire clay 1 0 / 15. Sandstone 15 0 / 16. Shale, sandy, lenticular, 0' to 5 0 / 17. Sandstone 10 0 — (62' 4") **Homewood Sandstone**	62	233	
18. Shale, sandy and dark	10	243	
19. **Coal,** soft 1' 2" / 20. Slate, dark 0 2 / 21. **Coal,** soft 0 10 — (2' 2") **Tionesta** (1380' B.) Baltimore & Ohio Railroad Exposure **(No. 394 on Map II)**	2	245	154
22. Fire clay, plastic, **Mt. Savage**	10	255	
23. Sandstone, massive, cliff, 80' 0" / 24. Concealed 10 0 / 25. Sandstone, massive, pebbly 75 0 — **Upper Connoquenessing**	165	420	
26. Slate, black, fissile, **Quakertown**	0½	420½	

		Tks. Ft.	Ttl. Ft.	Int. Ft.
27. Coal ....0′ 5″ 28. Shale, dark ....0 9 29. Coal, slaty 1 2	(2′ 4″) Quakertown (1420′ B.) Baltimore & Ohio Railroad Exposure (No. 403 on Map II)	2½	423	178
30. Fire clay shale		5	428	
31. Sandstone, massive, Lower Gilbert?		40	468	
32. Concealed and sandy shale		50	518	
33. Sandstone, massive, Nuttall?		15	533	
34. Shale, sandy, partly concealed		20	553	
35. Sandstone, Guyandot?		10	563	
36. Slate, dark, coaly, with plant fossils, Sewell (Sharon?) Coal horizon, (1470′ B.), Baltimore & Ohio Railroad Exposure (No. 405 on Map II)		2	565	142
37. Shale, sandy		5	570	
38. Sandstone, massive, coarse, with plant fossils, Sharon (Upper Raleigh?)		35	605	
39. Concealed by debris		25	630	
40. Shale, red, Mauch Chunk		....	.....	

MEASURED SECTIONS, ELK DISTRICT, MINERAL COUNTY.

Elk District embraces the extreme western end of Mineral County, and being traversed by portions of the North Potomac (Georges Creek) and Stony River Synclines, its surface rocks are wholly those of the Pennsylvanian, ranging from the Monongahela to the Pottsville Series.

The following section, measured with hand-level and arranged in descending order, starts at the top of a high knob, 0.6 mile southeast of Warnocks, and extends northeastward along the strike of the rocks to the New Creek Mine of the Masteller Coal Company (No. 301 on Map II) on Piney Swamp Run, 0.4 mile southwest of Hampshire, and gives a full measurement of the Conemaugh Series, as well as portions of the Monongahela and Allegheny. In passing from Piedmont up the Potomac the Mahoning ("Six-foot") Coal becomes irregular near this locality, while the Upper Freeport ("Split-six," "Davis"), which is of small value in the vicinity of Piedmont, suddenly thickens to a commercial bed and so continues southwestward. This important change in the relative thickness of the two seams has long been a stumbling block to the proper correlation of these two coals, but reference to the Piedmont Section on page 155 shows that the fossiliferous Brush Creek Shale at Piedmont lies 117 feet above the base of the Upper Freeport horizon and at Hampshire it is 115 feet, and as the Brush Creek can scarcely be misinterpreted at either point and its interval tallies so closely, there can be little further doubt* of the change which takes place in the two coals.

*Unless we concede that the coal bed identified as "Mahoning"

Hampshire Section, Elk District.

	Tks. Ft.	Ttl. Ft.	Int. Ft.
Monongahela Series (110′)			
1. Sandstone, massive, capping knob, **Sewickley**	30	30	
2. Concealed	80	110	
3. **Coal, Pittsburgh**, at old workings, (1890′ B.), (Mine No. 9 on Map II), fallen shut	....	110	110
Conemaugh Series (800′)			
4. Concealed, sandy shale, and concealed	145	255	
5. **Coal blossom, Little Clarksburg, ("Dirty Nine-foot," "Franklin")** (1745′ B.) (Exposure No. 49 on Map II)	....	255	145
6. Shale, sandy, partly concealed along ridge	80	335	
7. Sandstone, massive 6′			
8. Shale, sandy 5	Hoffman 45	380	
9. Sandstone, shaly 34			
10. Concealed	5	385	
11. Black slate and **coal blossom**, at spring, **Normantown, (Upper Hoffman?)**, (1615′ B.), (Exposure No. 59 on Map II)	....	385	130
12. Concealed and shale	101	486	
13. **Coal**, bony 0′ 7½″			
14. Slate, dark 0 1½			
15. **Coal**, bony 0 8	(4′ 3″) **Elk Lick, ("Four-foot," "Barton,")** (1510′B.),		
16. Slate, dark 0 3	Masteller Coal Company	4	490	105
17. **Coal**, medium-soft 2 5	No. 5 Mine (No. 80 on Map II).		
18. Bone 0 2			
19. Sandstone, sandy shale, and concealed	90	580	
20. Shale, greenish, **Ames**	....	580	
21. Concealed and sandy shale	60	640	
22. Sandstone, massive, **Saltsburg**	38	678	
23. Shale, dark, partly concealed	27	705	
24. **Coal blossom, Upper Bakerstown**, (1295′ B.), Masteller Coal Company Prospect (No. 167 on Map II), fallen shut	....	705	215
25. Concealed	33	738	
26. **Coal blossom, Bakerstown ("Thomas")** (1262′ B.)	....	738	33
27. Concealed and shale	26	764	
28. Sandstone, massive, **Buffalo**	30	794	
29. Shale, dark, with marine fossils, **Brush Creek**	6	800	
30. **Coal blossom, Brush Creek** (1200′ B.), Masteller Coal Company Exposure (No. 249 on Map II)	....	800	62
31. Concealed	45	845	
32. Sandstone, massive, **Upper Mahoning**	10	855	
33. Concealed	5	860	
34. **Coal, Mahoning ("Six-foot")**, (1140′ B.), Masteller Coal Company Prospect (No. 281 on Map II), fallen shut	....	860	60
35. Concealed	28	888	

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at Westernport and vicinity is really the Upper Freeport Coal which the State Geologist thinks is quite probable, the interval between it and the Brush Creek Coal having varied several feet here as it often does elsewhere. (I. C. W.)

	Tks. Ft.	Ttl. Ft.	Int. Ft.
36. Sandstone, shaly, **Lower Mahoning**	16	904	
37. Shale, sandy, **Uffington**	6	910	
Allegheny Series (15′)			
38. **Coal**, soft ....1′ 2″			
39. Shale, gray 0 7			
40. **Coal**, soft 1 2½			
41. Slate, bony 0 1½			
42. **Coal**, soft 1 6			
43. Bone 0 2			
(4′ 9″) **Upper Freeport** (**"Split - six," "Davis"**), (1085′ B.), Masteller Coal Company, New Creek Mine (**No. 301 on Map II**)	5	915	55
44. Fire clay shale, with limestone nodules, **Upper Freeport Limestone**	10	925	

The following section, measured with hand-level and arranged in descending order, starts at an old mine in the Elk Lick Coal in Garrett County, Maryland, about one-third mile west of Barnum and extends eastward down the hillside to the North Branch of Potomac River at Barnum. A persistent search of the shales failed to reveal any marine fossils in the Conemaugh Series, although the positions of the Ames and Brush Creek are apparent by interval from the known coals and the Pine Creek Limestone horizon would belong in No. 13 or possibly No. 14 of the section:

Barnum Section, Garrett County, Maryland.

	Tks. Ft.	Ttl. Ft.	Int. Ft.
Conemaugh Series (425′)			
1. **Coal mine**, abandoned, **Elk-Lick ("Four-foot," "Barton")**, (1660′ B.), Monroe Coal Mining Company Mine (**No. 83 on Map II**)	....	.....	
2. Concealed, with shale	60	60	
3. Sandstone, massive, **Grafton**	28	88	
4. Concealed	35	123	
5. Shale, dark, **Ames** (1537′ B.)	....	123	123
6. Concealed	22	145	
7. Sandstone, massive	33	178	
8. Concealed	27	205	
9. Sandstone, massive, **Saltsburg**	22	227	
10. Shale, sandy, ferriferous	5	232	
11. Slate, bony ....0′ 6′			
12. **Coal**, good 2 8			
(3′ 2″) **Bakerstown** (**"Thomas"**), (1425′ B.), Monroe Coal Mining Company Mine (**No. 189 on Map II**)	3	235	112
13. Concealed	32	267	
14. Shale, sandy	30	297	
15. Sandstone, **Buffalo**	40	337	
16. Concealed and dark shale, **Brush Creek** (1315′ B.)	8	345	110
17. Shale, sandy	22	367	
18. Concealed	16	383	

	Tks. Ft.	Ttl. Ft.	Int. Ft.
19. Sandstone, massive, **Lower Mahoning**	38	421	
20. Shale, dark, **Uffington**	4	425	
Allegheny Series (50′)			
21. **Coal** 2′ 1″			
22. Shale, gray 1 1			
23. **Coal** 0 10 (4′ 9″) **Upper Freeport** ("Split - six," "Davis"), (1230′ B.) Monroe Coal Mining Company Mine (No. 305 on Map II).	5	430	85
24. Slate, dark 0 1			
25. **Coal** 0 8			
26. Fire clay and concealed	5	435	
27. Sandstone, massive, **Upper Freeport**, to North Branch of Potomac River	40	475	

The following section, measured with aneroid and arranged in descending order, starts with the Pittsburgh Coal in a high hill 1.1 miles east of the railroad station at Shaw and extends westward to the North Branch of Potomac River at the station, the line of traverse mainly following the county road. Owing to the westward dip of the rocks, amounting approximately to 100 feet, the intervals are greater than true vertical measurement would show. There is also a large concealed interval in the lower portion so that nothing could be identified below the Harlem Coal:

Howell Run Section, Elk District.

	Tks. Ft.	Ttl. Ft.	Int. Ft.
Monongahela Series ( )			
1. **Coal, Pittsburgh**, abandoned workings, (2075′ B.), **(Exposure No. 15 on Map II)**	....	.....	
Conemaugh Series (790′)			
2. Concealed and shale	140	140	
3. Sandstone, massive, **Connellsville**	20	160	
4. Concealed	15	175	
5. **Coal blossom, Little Clarksburg, ("Dirty Nine-foot," "Franklin")**, (1900′ B.)	....	175	175
6. Shale, sandstone, and concealed	15	190	
7. **Coal blossom** (1885′ B.)	....	190	
8. Shale, sandy	10	200	
9. Sandstone, massive, **Lower Connellsville**	20	220	
10. Concealed	40	260	
11. Fire clay and **coal blossom, Normantown** (1815′ B.)	....	260	85
12. Shale, sandy, partly concealed	30	290	
13. Sandstone, shaly	15	305	
14. Shale, dark, streak	....	305	
15. Shale, sandy	25	330	
16. Concealed	10	340	
17. **Coal blossom, Lower Hoffman** (1735′ B.)	....	340	80
18. Fire clay shale and concealed	50	390	
19. **Coal blossom, "Barton Rider"** (1685′ B.)	....	390	
20. Fire clay, concealed, and sandy shale	29	419	
21. **Coal, (1′ 4″), Elk Lick, ("Four-foot," "Barton")**			

	Tks. Ft.	Ttl. Ft.	Int. Ft.
(1655′ B.), (Exposure No. 88 on Map II)	1	420	80
22. Shale, sandy	5	425	
23. Coal (0′ 4″)	....	425	
24. Shale, sandy	15	440	
25. Sandstone, shaly ....20′ 0″ ⎫			
26. Shale, sandy .....10 0 } Upper Grafton	40	480	
27. Sandstone, massive 10 0 ⎭			
28. Shale, sandy, dark	5	485	
29. Coal blossom, Federal Hill (1590′ B.)	....	485	65
30. Concealed	45	530	
31. Sandstone, Grafton	20	550	
32. Concealed	10	560	
33. Coal blossom, heavy, Harlem (1515′ B.) (Exposure No. 146 on Map II)	....	560	75
34. Concealed, to North Branch of Potomac River at Shaw Station	230	790	

The following section, measured with aneroid and arranged in descending order, starts at the top of a high hill 0.8 mile northeast of Elk Garden and extends northeastward mainly with the county road to Shaw. The line of traverse is approximately parallel to the axis of the Stony River Syncline but in this locality the basin plunges northward so that there is a dip of more than 200 feet in the strata through the distance covered by the section, making the apparent intervals between coals much too large, especially between the Pittsburgh and Harlem, but the relationship of several small beds not often exposed in the valley is indicated and the section should therefore be of some value:

Shaw Section, Elk District.

	Tks. Ft.	Ttl. Ft.	Int. Ft.
Monongahela Series (105′)			
1. Concealed, with sandstone and shale, from top of knob	5	5	
2. Limestone boulders, Sewickley (2305′ B.)	....	5	5
3. Concealed, with sandstone	69	74	
4. Snale, sandy	20	94	
5. Coal .....1′ 2″ ⎫			
6. Slate, black ....0 6 | (11′ 2″) Pittsburgh (2205′			
7. Coal .....6 8 } B.) Thomas Dixon Farm	11	105	100
8. Slate, dark .....0 4 | Mine (No. 17 on Map II)			
9. Coal .....2 6 ⎭			
Conemaugh Series (904′)			
10. Concealed, with sandstone and shale	200	305	
11. Slate, black, Little Clarksburg, ("Dirty Ninefoot," "Franklin") Coal horizon (2005′ B.)	....	305	200
12. Concealed and shale	20	325	
13. Sandstone, massive, partly concealed, Lower Connellsville	100	425	

	Tks. Ft.	Ttl. Ft.	Int. Ft.
14. Spring, with dark shale and fire clay, **Normantown Coal horizon** (1885′ B.)	....	425	120
15. Shale, sandy and limy, partly concealed	65	490	
16. Sandstone, massive, **Morgantown**	35	525	
17. Shale, dark, sandy	20	545	
18. **Coal blossom, Wellersburg "Rider"** (1765′ B.)	....	545	
19. Concealed	15	560	
20. **Coal blossom, Wellersburg** (1750′ B.)	....	560	
21. Shale, sandy	35	595	
22. **Coal blossom, Barton "Rider"** (1715′ B.)	....	595	
23. Shale, sandy	15	610	
24. **Coal blossom, Elk Lick, ("Four-foot," "Barton")** (1700′ B.)	....	610	185
25. Shale, sandy	10	620	
26. Sandstone, massive, **Upper Grafton**	9	629	
27. Shale, dark	1	630	
28. Shale, sandy	25	655	
29. **Coal blossom, Federal Hill** (1655′ B.)	....	655	
30. Shale and concealed	10	665	
31. **Coal blossom, Duquesne** (1645′ B.)	....	665	
32. Concealed and sandy shale	25	690	
33. Sandstone, massive, **Grafton**	35	725	
34. Shale, sandy	18½	743½	
35. **Coal blossom, Harlem,** (1565′ B.), **(Exposure No. 147 on Map II)**	1½	745	135
36. Shale, greenish-gray	34	779	
37. **Coal** (1530′ B.)	1	780	
38. Concealed and shale, partly red, **Pittsburgh Reds**	55	835	
39. Sandstone, massive, **Saltsburg**	35	870	
40. Concealed	20	890	
41. **Coal blossom** and fire clay, **Upper Bakerstown** (1420′ B.)	....	890	145
42. Concealed	11	901	
43. Sandstone, massive, **Thomas**	15	916	
44. Shale, dark	2	918	
45. **Coal** 0′ 5″ 46. **Coal** and bone 0 3 47. **Coal** 0 11 — (1′ 7″) **Bakerstown ("Thomas")** (1390′ B.) Farm Mine **(No. 194 on Map II)**	2	920	30
48. Shale and concealed	30	950	
49. Sandstone, massive, cliff, **Buffalo**	25	975	
50. Concealed, to Western Maryland Railway at Shaw	34	1009	

In the following section, measured principally with aneroid and arranged in descending order, Nos. 1-30 were observed in the immediate vicinity of Elk Garden, starting at the top of the hill about 0.6 mile southwest of the town and extending first northeastward to the town and then northwestward along the road toward Blaine. Below this level the measures are poorly exposed for a considerable distance along the road and the section is continued by outcrops starting at the same stratigraphic level one-half mile south of

Blaine and descending northeastward to the road again at a point one-third mile east of Blaine and then following the same nearly to the foot of the hill. The Bakerstown and Upper Freeport Coals are not mined along the road, however, and their sections as observed at mines a short distance up the river are included at the proper horizons. Nos. 71-79, as indicated in the section, are exposed in the river bluff just northeast of Blaine at which locality the East Lynn Sandstone is only partly above drainage but at the turn of the river farther north it makes an immense cliff on the Maryland side, the Lower Kittanning Coal being exposed just below it. In that portion of the section included between Nos. 14 to 30 there is a westward rise of the rocks so that intervals indicated in this part are less than true vertical measurement would show:

Elk Garden Section, Elk District.

		Tks. Ft.	Ttl. Ft.	Int. Ft.
Monongahela Series (171')				
1. Sandstone, **Sewickley**, from top of knob		40	40	
2. Shale, gray (0' 6")		0½	40½	
3. **Coal** 5' 1"	**(5' 9") Sewickley, "Tyson" (2440' B.) Dean Coal Company No. 4 (Tyson) Mine (No. 2 on Map II)**	5½	46	46
4. Shale, dark 0 3				
5. **Coal** 0 5				
6. Shale, sandy, partly concealed		56	102	
7. Sandstone, **Cedarville**		10	112	
8. **Coal blossom, Redstone** (2370' B.) **(Exposure No. 5 on Map II)**		4	116	70
9. Shale, sandstone, and sandy shale, partly concealed		43	159	
10. **Coal**, reported 2' 6"	**(11' 11") Pittsburgh (2315' B.) Dean Coal Company No. 4 (Pittsburgh) Mine (No. 20 on Map II)**	12	171	55
11. **Coal** 6 10				
12. Shale, gray 0 2				
13. **Coal** 2 5				
Conemaugh Series (751')				
14. Shale, sandy, partly concealed		39½	210½	
15. **Coal streak, (0' 6"), Morantown, (2300' B.) (Exposure No. 37 on Map II)**		0½	211	
16. Shale, sandy		10	221	
17. Sandstone, shaly, **Lower Pittsburgh**		5	226	
18. Shale, sandy		4	230	
19. **Coal**, slaty, **Little Pittsburgh, (2280' B.), (Exposure No. 40 on Map II)**		1	231	
20. Shale, sandy, partly concealed		35	266	
21. **Coal blossom**, slaty, **Second Little Pittsburgh, (2245' B.), (Exposure No. 42 on Map II)**		....	266	
22. Shale, sandy		9	275	
23. **Coal blossom, Franklin "Rider,"** (2235' B.), **(Exposure No. 43 on Map II)**		1	276	
24. Shale, sandy and concealed		10	286	

	Tks. Ft.	Ttl. Ft.	Int. Ft.
25. **Coal blossom**, heavy, **Little Clarksburg** ("Dirty Nine-foot," "Franklin"), (2225' B.), (Exposure No. 55 on Map II)	....	286	115
26. Shale, sandy	20	306	
27. Sandstone, massive, **Lower Connellsville**	20	326	
28. Shale, sandy and concealed	40	366	
29. Dark shale and **coal blossom, Lower Clarysville?**, (2145' B.), (Exposure No. 65 on Map II)	....	366	
30. Shale variegated	20	386	
(Section continued by exposures south of Blaine):			
31. Limestone, gray, hard	1	387	
32. Concealed and sandy shale	79	466	
33. **Coal, Elk Lick** ("Four-foot," "Barton"), (2130' B.), Grafton Mining Company Prospect (No. 98 on Map II), reported	1	467	181
34. Concealed	99	566	
35. Shale, green, with marine fossils, **Ames**	20	586	
36. **Coal** ....0' 4"			
37. Shale, gray 0 4	(0' 9") **Harlem** (2010' B.) John Kitzmiller Prospect (No. 151 on Map II)	1	587	120
38. **Coal**, visible ..0 1			
39. Concealed and yellow shale, **Pittsburgh Reds**	70	657	
40. Sandstone, massive, **Saltsburg**	15	672	
41. Shale, sandy	5	677	
42. **Coal**, soft .....2' 6"			
43. Shale, dark 0 6	(5' 0") **Upper Bakerstown** (1915' B.) John Kitzmiller Exposure (No. 173 on Map II)	5	682	95
44. **Coal**, soft 2 0			
45. Fire clay and sandy shale	16	698	
46. Sandstone, shaly, **Thomas**	15	713	
47. Shale, dark	4	717	
48. **Coal**, bony ....0' 9"			
49. **Coal**, very h'rd 0 8			
50. Bone 0 1	(5' 1") **Bakerstown** ("Thomas") (1875' B.) Grafton Mining Company, Freeport Mine (No. 202 on Map II)	5	722	40
51. **Coal**, medium-hard 0 5			
52. Bone 0 7			
53. **Coal**, soft 2 7			
54. Shale, concealed, and shale	45	767	
55. Shale, ferriferous, (0' 4"), **Pine Creek Limestone horizon**	....	767	
56. Sandstone, massive, **Buffalo**	25	792	
57. Shale, dark, with marine fossil fragments, **Brush Creek** (1790' B.)	15	807	85
58. Concealed	20	827	
59. Fire clay	5	832	
60. Concealed	16	848	
61. Sandstone, massive, **Upper Mahoning**	30	878	
62. Shale, dark	4	882	
63. **Coal**, bony ....0' 10"			
64. Bone 0 11	(4' 9") **Mahoning** ("Six-foot") (1710' B.) Fortney & Piles Mine (No. 285 on Map II)	5	887	80
65. **Coal**, soft 3 0			
66. Shale, sandy	35	922	

	Tks. Ft.	Ttl. Ft.	Int. Ft.
Allegheny Series (174′)			
67. Coal, bony .....0′ 4″			
68. Coal, soft 1 7			
69. Shale, gray, hard 1 4	5	927	40
70. Coal, soft 1 8			
(4′ 11″) Upper Freeport, ("Split-six," "Davis") (1735′ B.) Grafton Mining Company, Split-six Mine (No. 308 on Map II)			
(Section continued by exposures along Potomac northeast of Blaine):			
71. Fire clay and concealed	5	932	
72. Sandstone, massive, pebbly, **Lower Freeport**	50	982	
73. Slate, black	1	983	
74. Coal .....1′ 8″			
75. Slate, black ..0 3			
76. Coal 0 2	2	985	58
(2′ 1″) Upper Kittanning (1630′ B.) Western Maryland Railway Exposure (No. 362 on Map II)			
77. Shale, sandy, ferruginous, **Johnstown Limestone horizon**	25	1010	
78. Concealed	5	1015	
79. Sandstone, massive, great cliff, **East Lynn**	50	1065	
80. Coal (0′ 10″), **Lower Kittanning** (1595′ B.), (Exposure No. 383 on Map II)	1	1066	81
81. Fire clay, **Lower Kittanning**, visible	5	1071	
82. Concealed, to Potomac River at bend 0.5 mile northeast of Blaine	25	1096	

The following section, measured with hand-level and arranged in descending order, starts at the top of a high knob one mile south of Gleason and just west of Empire School and extends northward to the North Branch of Potomac River at Gleason. Owing to the northeastward dip in this locality intervals are slightly greater than true vertical measurement would show:

Gleason Section, Elk District.

	Tks. Ft.	Ttl. Ft.	Int. Ft.
Conemaugh Series (676′)			
1. Sandstone, massive, partly concealed, from top of knob	45	45	
2. Concealed, mostly shale	165	210	
3. **Coal blossom**, at spring, **Elk Lick ("Four-foot," "Barton")**, (2465′ B.), **(Exposure No. 116 on Map II)**	....	210	210
4. Concealed, with shale and sandstone	87	297	
5. Spring, with fire clay, **Federal Hill Coal horizon**	....	297	
6. Concealed, with sandstone and shale	44	341	
7. Shale, sandy, with marine fossils, **Ames**, (2334′ B.), thickness concealed	....	341	131
8. Concealed	94	435	
9. Bench, with dark slate, **Upper Bakerstown Coal horizon**	....	435	94
10. Concealed	26	461	
11. Sandstone, shaly, **Thomas**	10	471	

		Tks. Ft.	Ttl. Ft.	Int. Ft.
12. Shale, dark		1	472	
13. **Coal** 0′ 3″	(3′ 3″) **Bakerstown**			
14. **Coal,** bony 0 3	(**"Thomas"**) (2200′ B.)			
15. **Coal** 0 6	Gleason Coal & Coke	3	475	40
16. **Coal,** bony 0 8	Company Prospect (**No.**			
17. **Coal** 1 7	214 on Map II)			
18. Concealed		48	523	
19. Sandstone, massive, partly concealed, **Buffalo**		37	560	
20. Concealed in bench, **Brush Creek Coal horizon**		....	560	85
21. Concealed and dark shale		73	633	
22. Bone 0′ 2½″	(3′ 11″) **Mahoning ("Six-**			
23. **Coal,** soft 1 0	**foot")** (2015′ B.) Gleason			
24. Sulphur band 0 2½	Coal & Coke Company	4	637	77
25. **Coal,** soft 2 4	No. 3 Mine (**No. 289 on**			
26. Bone 0 2	Map II)			
27. Concealed		30	667	
28. Shale, dark, sandy, **Uffington**		9	676	
Allegheny Series (206′)				
29. **Coal,** soft 1′ 8 ″				
30. Shale, gray 1 5½	(7′ 1″) **Upper Freeport**			
31. **Coal,** soft 0 11	(**"Split - six," "Davis"**)			
32. Slate, black 0 1	(1970′ B.) Gleason Coal &	7	683	46
33. **Coal,** soft 1 4	Coke Company No. 1			
34. Slate, black 0 1½	Mine (**No. 315 on Map II**)			
35. **Coal,** soft 1 6				
36. Concealed		180½	863½	
37. **Coal, Lower Kittanning,** (1810′ B.) Gleason Coal & Coke Company Prospect (**No. 386 on Map II**), fallen shut, reported		1½	865	182
38. Concealed		17	882	
Pottsville Series (28′)				
39. Sandstone, massive, **Homewood,** to North Branch of Potomac River		28	910	

The following section, measured with aneroid and arranged in descending order, starts at the top of the point in Garrett County, Maryland, about three-fourths mile northwest of Hubbard, and extends down to the North Branch of Potomac River at Hubbard. Being on the northern nose of the Blackwater Anticline the upper portion of the Pottsville Series is exposed along the river:

Hubbard Section, Garrett County, Maryland.

		Tks. Ft.	Ttl. Ft.	Int. Ft.
Conemaugh Series (312′)				
1. Sandstone, massive, pebbly, capping ridge, **Saltsburg**		40	40	
2. Concealed and dark shale		46	86	
3. **Coal,** soft 0′ 10″	(3′ 10″) **Upper Bakerstown**			
4. **Coal,** bony 0 8	(2460′ B.) Hubbard Coal			
5. **Coal,** soft 2 4	Mining Company Mine (**No. 177 on Map II**)	4	90	90
6. Shale and concealed		40	130	

7. Coal blossom, Bakerstown ("Thomas") (2405' B.)	....	130	40
8. Concealed with shale	40	170	
9. Sandstone, massive, **Buffalo**	30	200	
10. Shale, dark, with marine fossil fragments, **Brush Creek**	20	220	
11. Coal blossom, Brush Creek (2315' B.)	....	220	90
12. Sandstone, **Upper Mahoning**	10	230	
13. Shale, sandy	20	250	
14. Shale, with flint fire clay, **Thornton**, and iron ore nodules	45	295	
15. Sandstone, massive, **Lower Mahoning**	10	305	
16. Shale, dark, **Uffington**	7	312	
Allegheny Series (198')			
17. Coal 1' 0"			
18. Shale, gray 1 0			
19. Coal 0 10	(8' 3") Upper Freeport ("Split-six", "Davis")		
20. Shale, gray 2 9			
21. Coal 0 4½	(2215' B.) Hubbard Coal	8	320 100
22. Slate 0 1½	Mining Company Mine		
23. Coal 1 1	(No. 316 on Map II)		
24. Slate, dark 0 1			
25. Coal 1 0			
26. Shale, concealed, and shale	85	405	
27. Sandstone, massive, **Lower Freeport**	15	420	
28. Concealed	45	465	
29. Coal blossom, Lower Kittanning (2070' B.)	....	465	145
30. Shale, sandy	10	475	
31. Concealed	35	510	
Pottsville Series (170')			
32. Sandstone 30'			
33. Concealed 40			
34. Slate, black, streak ... } **Homewood**	95	605	
35. Sandstone, massive 25			
36. Concealed, with shale	20	625	
37. Sandstone, massive, **Upper Connoquenessing**, to North Branch of Potomac River.	55	680	

The following section, measured with aneroid and arranged in descending order, starts at the top of a knob 0.7 mile south of Schell School and extends northward and westward with the county road to Schell village. Owing to the westward rise of the rocks toward the Blackwater Anticline, amounting to nearly 100 feet along the line of traverse, the intervals indicated are somewhat less than true vertical measurement would show. Exposures in the Conemaugh Series are very poor and some doubt as to the correlations is expressed:

Schell Section, Elk District.

	Tks. Ft.	Ttl. Ft.	Int. Ft.
Conemaugh Series (573')			
1. Concealed, with sandstone	60	60	
2. Concealed, in gentle slope	165	225	

	Tks. Ft.	Ttl. Ft.	Int. Ft.
3. Sandstone, **Barton**	10	235	
4. Sulphur spring, with fire clay, **Elk Lick Coal horizon?** (2615′ B.)	....	235	235
5. Concealed, with shale	100	335	
6. **Coal blossom, Harlem** (2515′ B.)	....	335	100
7. Concealed	10	345	
8. Sandstone, **Jane Lew**	10	355	
9. Concealed	40	395	
10. Sandstone, **Saltsburg**	5	400	
11. Shale, sandy and concealed	30	430	
12. Fire clay and **coal blossom, Upper Bakerstown** (2420′ B)	....	430	95
13. Concealed	25	455	
14. **Coal blossom, Bakerstown** ("Thomas") (2395′ B.)	....	455	25
15. Concealed	15	470	
16. Shale, dark, streak	....	470	
17. Concealed	10	480	
18. Sandstone, massive, **Buffalo**	30	510	
19. Shale, dark, with marine fossil fragments?, **Brush Creek** (2325′ B.)	15	525	70
20. Concealed and shale	10	535	
21. Sandstone, partly concealed, **Lower Mahoning**	33	568	
22. Shale, dark, **Uffington**	5	573	
Allegheny Series (222′)			
23. **Coal**, medium-soft 2′ 0″			
24. Shale, gray, hard 1 11			
25. **Coal** 0 5	(7′ 3″) **Upper Freeport, ("Split - six," "Davis")** (2270′ B.) Schell Coal Company Mine (No. 317 on Map II)		
26. Shale, gray 1 1			
27. **Coal** 0 5½		7	580 55
28. Shale, dark 0 2			
29. **Coal** 0 5½			
30. Slate, dark 0 2			
31. **Coal** 0 7			
32. Concealed		30	610
33. Sandstone, **Upper Freeport**, and concealed		10	620
34. **Coal blossom, Lower Freeport** (2230′ B.)		....	620 40
35. Concealed		94	714
36. **Coal blossom, Upper Kittanning**, (2135′ B.) **(Exposure No. 366 on Map II)**, visible		1	715 95
37. Shale, sandy, with iron ore, **Johnstown**		20	735
38. Sandstone, concealed, and sandstone, **East Lynn**		54	789
39. **Coal blossom, Lower Kittanning**, (2060′ B.) **(Exposure No. 387 on Map II)**, visible		1	790 75
40. Shale		5	795
Pottsville Series (80′)			
41. Sandstone, massive, pebbly, cliff rock, **Homewood**, to North Branch of Potomac River at Schell		80	875

MEASURED SECTIONS, GRANT COUNTY.

Grant County, like Mineral, contains a portion of the comparatively flat-lying Pennsylvanian rocks west of the

Allegheny Front and a large area of the more disturbed lower measures of the eastern region. Its surface strata range from the Monongahela Series of the Pennsylvanian down to the upper portion of the Martinsburg Shale of the Ordovician.

MEASURED SECTIONS, GRANT DISTRICT, GRANT COUNTY.

Grant District occupies the northeastern corner of the county between New Creek Mountain on the west and Patterson Creek Mountain on the east, all of it being in the highly disturbed area so that measurement of thicknesses is uncertain and laborious. Its surface rocks range from the Chemung Series of the Devonian to the Red Medina of the Silurian.

The following section, arranged in descending order, starts at the outcrop of the Oriskany Sandstone just northwest of Falls and extends northwestward up North Fork of Patterson Creek to the axis of the Wills Mountain Anticline at the center of Greenland Gap, all thicknesses having been reduced to vertical measurement by trigonometry. It is possible that the contact of the Helderberg and Bossardville Limestones has been placed too low in the section, as there is a considerable concealed interval in No. 5 where the Stromatopora beds, which indicate the base of the Devonian, should occur. The Red Medina at the base of the section is almost totally concealed by debris from the great White Medina cliff which covers the arch on either side of the creek so that detailed examination of these red beds was impossible. It seems probable that the thickness of 745 feet represents almost all of this group:

Falls Section, Grant District.

	Thickness. Feet.	Total. Feet.
Oriskany Sandstone (75′)		
1. Sandstone, massive, yellowish-brown, fossiliferous, **Oriskany**	75	75
Helderberg Limestone (976′)		
2. Limestone, cherty, fossiliferous, **New Scotland member**	130	205
3. Concealed	132	337
4. Limestone, gray, hard, fossiliferous (**Brachiopods, etc.**); upper portion makes cliff, lower portion partly concealed	390	727
5. Limestone, dark, brecciated at top, partly concealed	324	1051
Bossardville Limestone (210′)		
6. Limestone, gray, flaggy, trapezoidal weathering	210	1261
Rondout Waterlime (647′)		
7. Limestone, dark	262	1523
8. Concealed	330	1853

	Thickness. Feet.	Total. Feet.
9. Limestone, gray	55	1908
Bloomsburg Red Shale (105')		
10. Sandstone, greenish-brown, fine-grained	25	1933
11. Shale, sandy, greenish-gray	80	2013
Niagara Limestone (291')		
12. Limestone, shaly, very fossiliferous	291	2304
Clinton Group (629')		
13. Shale, gray, sandy, with lenses of fossiliferous limestone	26	2330
14. Iron ore 1' 0"		
15. Shale, sandy 4 0		
16. Iron ore, red, fossiliferous 4 0 } Fossil Ore	13	2343
17. Shale, sandy and ferriferous, } Horizon		
to bottom of pit 4 0		
18. Shale, sandy	34	2377
19. Concealed	287	2664
20. Sandstone, red, ferriferous, "Iron Sandstone," (supplied from west limb of arch)	20	2684
21. Concealed	249	2933
White Medina Sandstone (317')		
22. Sandstone, massive, hard, white and quartzitic	317	3250
Red Medina (745')		
23. Concealed, with red shales and sandstones, to axis of arch at bridge across North Fork of Patterson Creek	745	3995

The following section, arranged in descending order, starts at the Portage-Genesee contact on Lunice Creek one-half mile east of the highway bridge at Maysville and extends westward up the creek to the Oriskany Sandstone at the bridge, including Nos. 1-9 of section. The remaining portion, Nos. 10-23, was measured in the western end of Cosner Gap, starting with the Oriskany Sandstone and traversing eastward toward the axis of the Wills Mountain Anticline, and ending with the base of the White Medina Sandstone. The Genesee Black Shale appears to be represented only by the brown shale and limestone nodules of No. 2. This section indicates quite clearly the presence of two benches of the Lower Selinsgrove Limestone, there being one indicated by Dr. I. C. White and others in eastern Pennsylvania where an upper bed occurs at a much higher level. In the Helderberg, Bossardville, and Rondout Limestones it was not found possible to obtain precise contacts, owing to concealed intervals and other difficulties:

Maysville Section, Grant District.

	Thickness. Feet.	Total. Feet.
1. Greenish-gray shale and sandstone, **Portage Series**	.....	.....
Genesee and Hamilton Series (339′)		
2. Shale, brown, with shaly, fossiliferous limestone nodules, contains Genesee fossils	36	36
3. Shale, brown, partly concealed	212	248
4. Concealed, mostly, with brown shale	91	339
Marcellus Series (835′)		
5. Shale, black, fissile, metallic lustre, largely concealed	425	764
6. Limestone, black, **Lower Selinsgrove,** upper bench	59	823
7. Concealed and black shale	49	872
8. Limestone, black, shaly, **Lower Selinsgrove,** lower bench	154	1026
9. Shale, black, partly concealed	148	1174
(Section continued by exposures near Brick Church on west limb of anticline, traverse eastward):		
Oriskany Sandstone (215′)		
10. Sandstone, coarse, yellowish-brown, limy at top, fossiliferous, **Ridgeley**	165	1339
11. Chert, yellowish-gray, sandy, **Shriver,** used for road surface	50	1389
Helderberg, Bossardville, and Rondout Limestones (1154′)		
12. Chert, gray and dark, mixed, **New Scotland**	50	1439
13. Limestone, gray, massive and fossiliferous at top, partly concealed at base, mostly **Helderberg**	370	1809
14. Limestone, gray, flaggy, **Bossardville and Rondout**	411	2220
15. Concealed, **Rondout**	213	2433
16. Limestone, shaly, **Rondout**	110	2543
Bloomsburg Red Shale (10′)		
17. Sandstone, greenish, flaggy	10	2553
Niagara Limestone (161′)		
18. Limestone, flaggy, fossiliferous, **Niagara**	161	2714
Clinton Series (312′)		
19. Concealed	161	2875
20. Sandstone, red, ferriferous, **"Iron Sandstone"**	65	2940
21. Sandstone, shale, and concealed	86	3026
White Medina Sandstone (212′)		
22. Sandstone, white, very hard, quartzitic, **White Medina**	212	3238
23. Red shales and reddish-gray sandstone, **Red Medina Series**	.....	.....

MEASURED SECTIONS, MILROY DISTRICT, GRANT COUNTY.

Milroy District occupies the southern end of Grant County, the extreme southern end of the district next to Pendleton County extending from the Allegheny Front on the west to South Fork Mountain on the east, and including surface rocks that range from the Pottsville Series of the Pennsyl-

Photo by E. E. HARRIS.

PLATE VIII.—View of Luke, Maryland, looking southward across North Branch of Potomac River toward foot-hills of Allegheny Front. Large mill is plant of West Virginia Pulp and Paper Company. Homewood Sandstone cliff in left middle along railroad grade. Topography of Conemaugh, Allegheny, and Pottsville Series.

vanian down to the Martinsburg Shale of the Ordovician. Owing to the highly disturbed condition of the rocks, including numerous local reversals, overturns, and in some cases faults, detailed measurement of the strata is at most points extremely difficult and often impossible.

The following section, arranged in descending order, was measured in North Fork Gap where North Fork of South Branch of Potomac River cuts through the Wills Mountain Anticline. It starts at the top of the White Medina Sandstone where this cliff rises above drainage on the eastern limb of the anticline 2 miles southwest of Corners and 2.9 miles northeast of Hopeville. Nos. 3-7 of section, including the upper portion of the Red Medina, start at the base of the White Medina cliff farther up the limb of the arch, 0.3 mile northwest of the first outcrop mentioned, these red beds being very well exposed by a landslide that has uncovered the bedded strata at this locality. From the base of No. 7 the section is continued westward to the axis of the arch by exposures in the bluff south of North Fork, the principal portion of the Martinsburg Shale being concealed but enough of its upper part being exposed to afford a determination of the Lower Maysville (of Ohio) fauna by Dr. Tilton from collections made by the writer:

Hopeville Section, Milroy District.

	Thickness. Feet.	Total. Feet.
1. Shales, red and ferriferous, **Clinton Series**	-----	-----
White Medina Sandstone (300')		
2. Sandstone, white, very hard, quartzitic (pebbly), **White Medina**	300	300
Red Medina Series (1015')		
3. Shale, reddish-brown, sandy, with streaks of greenish-red sandstone	160	460
4. Shale, reddish-brown, with streaks of greenish-red sandstone	90	550
5. Sandstone, greenish-brown, with beds of red shale	50	600
6. Concealed, with brown shale, to road	15	615
7. Concealed, from road to river	20	635
(Section continued by exposures westward along south side of North Fork):		
8. Concealed, with shale	89	724
9. Sandstones, reddish, or greenish-brown, with thin beds of red shale	591	1315
Gray Medina Sandstone (254')		
10. Sandstone, hard, medium-grained (no fossils)	8	1323
11. Shale, gray, very sandy (no fossils)	24	1347
12. Sandstone, gray, micaceous, with spots of iron oxide, and occasional quartz veins along slickensided bedding-planes, also thin intermediate		

	Thickness. Feet.	Total. Feet.
layers of gray, sandy shale (no fossils); angular unconformity at base	222	1569
Martinsburg Shale (296')		
13. Sandstone, shaly, dark, brecciated and much slickensided, contains small pelecypods and other fossils	62	1631
14. Sandstone, friable, brownish-black, with **Orthorynchula linneyi**, etc., **Lower Maysville** (of Ohio) **beds**	12	1643
15. Concealed, to axis of Wills Mountain Anticline	222	1865

MEASURED SECTIONS, UNION DISTRICT, GRANT COUNTY.

Union District comprises a large area in the northwestern part of Grant County extending from Fairfax Knob on Backbone Mountain eastward to New Creek Mountain and including between them the Allegheny Front. Its surface rocks range from the Monongahela Series of the Pennsylvanian, which outcrops in Fairfax Knob, down to the Red Medina of the Silurian, which is above drainage in certain of the gaps in New Creek Mountain. In the eastern part of the district where the folded rocks of the lower measures outcrop the stratigraphy is exhibited by the Falls and Maysville Sections published on pages 174 and 176, respectively. In the western part where the gently inclined Pennsylvanian beds are present there are few points where the strata are well enough exposed to give detailed surface measurements, as the deep gorge of the North Branch of Potomac River, along which good observations were possible farther down in Mineral County, largely disappears near the headwaters of the stream and such slopes as exist are covered with a thick deposit of debris so that long sections of consecutive bedded strata may not be seen. The details of this region may best be studied by reference to the numerous coal test borings, some of which are used as sections in this Chapter and others of which are published in Chapter XVII, and which afford an accurate record of the Pennsylvanian beds.

The following section, measured with aneroid and arranged in descending order, starts at the top of a knob, 0.6 mile southwest of Bayard, and extends northeastward to the North Branch of Potomac River at Bayard, but reveals only an incomplete portion of the Conemaugh Series:

Bayard Section, Union District.

Conemaugh Series (385′)	Tks. Ft.	Ttl. Ft.	Int. Ft.
1. Concealed, from top of point	25	25	
2. Sandstone, shaly, Barton	25	50	
3. Shale, sandy	10	60	
4. Concealed	15	75	
5. Shale, dark and sandy	23	98	
6. Coal, Elk Lick, ("Four-foot," "Barton"), (2625′ B.) (Exposure No. 129 on Map IV)	2	100	100
7. Shale, sandy	10	110	
8. Concealed	125	235	
9. Sandstone, massive, Grafton	25	260	
10. Concealed, sandstone boulders, and concealed, with dark shale at base	86½	346½	
11. Coal, medium-hard 1′ 6″ / 12. Shale, gray 0 2 / 13. Coal, medium-soft 1 10 — (3′ 6″) Bakerstown ("Thomas") W. A. Price Mine (No. 245 on Map IV)	3½	350	250
14. Concealed, to North Branch of Potomac River	35	385	

The following section is the record of a diamond drill test for coal located on the axis of the North Potomac (Georges Creek) Syncline in Garrett County, Maryland, 1.1 miles north of Wilson. It starts not far from the top of the Conemaugh Series and illustrates the southwestward thinning of the Little Clarksburg, Elk Lick, Upper Bakerstown, and Mahoning Coals, as well as the local absence of the Bakerstown:

Wilson Section, Garrett County, Maryland.
Record of
Davis Coal & Coke Company No. 84 Coal Test Boring (57).

Garrett County, Maryland; on a short branch of North Branch of Potomac River, 1.1 miles north of Wilson; authority, Davis Coal & Coke Company; completed, April 15, 1915; elevation, 2685′ L.

Conemaugh Series (693′ 5″)	Thickness. Ft.	In.	Total. Ft.	In.	Interval. Ft.	In.
Clay	5	0	5	0		
Sandstone, Connellsville?	16	0	21	0		
Fire clay	18	0	39	0		
Shale, light	15	0	54	0		
Shale, sandy	3	0	57	0		
Shale, dark	9	0	66	0		
Shale and sandstone	11	0	77	0		
Slate, black	4	0	81	0		
Coal, Little Clarksburg ("Franklin," "Dirty Nine-foot")	0	10	81	10	81	10
Shale, sandy	3	0	84	10		
Fire clay	6	0	90	10		

	Thickness.		Total.		Interval.	
	Ft.	In.	Ft.	In.	Ft.	In.
Shale, light	28	0	118	10		
Sandstone, **Lower Connellsville**	3	0	121	10		
Shale, light	30	0	151	10		
Shale, sandy	15	0	166	10		
Shale, dark	6	0	172	10		
Shale, light	7	0	179	10		
Shale, red	14	0	193	10		
Shale, dark	2	0	195	10		
Sandstone, **Morgantown**	10	0	205	10		
Fire clay	5	0	210	10		
Sandstone	6	2	217	0		
Shale, sandy	6	0	223	0		
Fire clay, shaly	5	0	228	0		
Shale, red	3	0	231	0		
Shale, light	9	0	240	0		
Shale, dark	2	6	242	6		
Shale and sandstone, **Barton**	10	6	253	0		
Slate, black	10	0	263	0		
Coal, Elk Lick	1	4	264	4	182	6
Shale, sandy	19	2	283	6		
Sandstone 13′ 0″ } **Upper** Conglomerate 2 0 } **Grafton**	15	0	298	6		
Shale, green	16	0	314	6		
Shale, dark	3	2	317	8		
Shale, mixed	19	4	337	0		
Sandstone 4′ 0″ } Shale and sandstone 9 2 } **Grafton** Sandstone, crystallized 3 0 }	16	2	353	2		
Slate, black, **Ames**	6	0	359	2		
Coal, Harlem	0	9	359	11	95	7
Fire clay	6	0	365	11		
Pittsburgh Red Shale: Shale, mixed 33′ 1″ } Shale, sandy 18 0 } Shale, dark 4 0 } Shale, red 6 0 }	61	1	427	0		
Shale, sandy	5	0	432	0		
Sandstone, **Jane Lew**	2	0	434	0		
Shale, sandy	5	0	439	0		
Pittsburgh Red Shale: Shale, dark 3′ 0″ } Shale, sandy 8 0 } Shale, variegated 1 0 } Shale, sandy 13 0 } Shale, red and light 12 0 }	37	0	476	0		
Fire clay, shaly	11	0	487	0		
Sandstone, **Thomas**	7	0	494	0		
Shale, light	2	0	496	0		
Sandstone	1	6	497	6		
Shale, light	5	0	502	6		
Sandstone 19′ 0″ } Shale, light 0 6 } **Buffalo** Sandstone 17 0 } Sandstone and shale 15 0 }	51	6	554	0		
Shale, sandy	3	0	557	0		
Shale, dark, sandy, **Brush Creek**	19	0	576	0		

	Thickness. Ft.	In.	Total. Ft.	In.	Interval. Ft.	In.
Coal, Brush Creek	0	8	576	8	216	9
Fire clay	1	0	577	8		
Sandstone, Upper Mahoning	12	0	589	8		
Shale, sandy	11	0	600	8		
Fire clay, shaly	8	0	608	8		
Shale, red, Mahoning	4	0	612	8		
Shale, dark	2	0	614	8		
Fire clay, shaly	4	4	619	0		
Sandstone, dark	1	4	620	4		
Shale, sandy	4	0	624	4		
Shale, variegated	1	6	625	10		
Sandstone, Lower Mahoning	45	0	670	10		
Slate, black, Uffington	22	7	693	5		
Allegheny Series (10′ 4″)						
Coal 0′ 9″ / Slate 0 2 / Coal 2 2 / Slate 0 11 / Coal 2 8 / Slate 0 3 / Coal 2 1 — Upper Freeport ("Split-Six," "Davis")	9	0	702	5	125	9
Fire clay, to bottom	1	4	703	9		

The following section is the record of another coal boring made on the Maryland side of the Potomac 0.5 mile southwest of Dobbin. It records the presence of both the Elk Lick and Upper Bakerstown Coals at their proper horizons, each of them being only one foot in thickness, as well as showing the Bakerstown Coal in normal development. A full discussion of the relationship of the two Bakerstown Coals will be found in Chapter VII:

Dobbin Section, Garrett County, Maryland.

Record of

Davis Coal and Coke Company No. 81 Coal Test Boring (73).

Garrett County, Maryland; on North Branch of Potomac River, 0.5 mile southwest of Dobbin; authority, Davis Coal & Coke Company; completed, October 24, 1914; elevation, 2644′ L.

Conemaugh Series (451′ 6″)	Thickness. Ft.	In.	Total. Ft.	In.	Interval. Ft.	In.
Clay and gravel	21	0	21	0		
Sandstone, hard	6	0	27	0		
Shale, dark, sandy	8	0	35	0		
Slate, black	4	0	39	0		
Coal, Elk Lick ("Barton," "Four-foot")	1	0	40	0	40	0
Shale	12	0	52	0		
Shale, hard, sandy	10	0	62	0		
Rock, hard	2	0	64	0		
Fire clay and shale	2	0	66	0		
Shale, light	3	0	69	0		

	Thickness.		Total.		Interval.	
	Ft.	In.	Ft.	In.	Ft.	In.
Shale, red	7	0	76	0		
Shale, sandy	8	0	84	0		
Fire clay and shale	3	0	87	0		
Shale, dark	14	0	101	0		
Sandstone, hard, Grafton	24	0	125	0		
Shale, dark, Ames	15	0	140	0		
Coal, Harlem	2	0	142	0	102	0
Shale, dark	6	0	148	0		
Shale, sandy	4	0	152	0		
Sandstone, hard, Saltsburg	34	0	186	0		
Shale, light, sandy	4	0	190	0		
Shale, dark	5	0	195	0		
Coal, Upper Bakerstown	1	0	196	0	54	0
Lime, shaly	2	0	198	0		
Fire clay	4	0	202	0		
Sandstone, Thomas	54	0	256	0		
Coal, Bakerstown ("Thomas")	5	6	261	6	65	6
Fire clay	8	6	270	0		
Sandstone, hard, Buffalo	36	0	306	0		
Shale, sandy	8	0	314	0		
Slate, black, Brush Creek	11	0	325	0		
Coal, Brush Creek	0	6	325	6	64	0
Shale, dark, sandy	1	6	327	0		
Sandstone, hard	16	0	343	0		
Limestone	1	6	344	6		
Fire clay	7	6	352	0		
Shale and fire clay	5	0	357	0		
Shale, gray, sandy	6	0	363	0		
Sandstone 14′ 0″ / Sandstone, hard 11 0 — Upper Mahoning	25	0	388	0		
Slate, black, Mahoning ("Six-foot") Coal horizon	4	0	392	0	66	6
Shale and slate, hard	19	0	411	0		
Lime and clay	3	0	414	0		
Shale, dark, sandy	8	0	422	0		
Sandstone, hard, Lower Mahoning	13	0	435	0		
Shale, dark 11′ 6″ / Slate, black 5 0 — Uffington	16	6	451	6		
Allegheny Series (10′ 0″)						
Coal 0′ 4″ / Binder 0 2 / Coal 2 8 / Binder 1 1 / Coal 3 6 — Upper Freeport ("Split-Six," "Davis")	7	9	459	3	67	3
Fire clay, to bottom	2	3	461	6		

The following section is the record of another coal boring near the mine shaft of the Davis Coal & Coke Company at Henry. Excerpts from this record have been previously published by Dr. G. C. Martin in the Garrett County Report of the Maryland Geological Survey, pages 108 and 112-113, and by Dr. I. C. White in Coal Report, Volume II, of the West Virginia Geological Survey, pages 352-353, the former

being published in 1902 and the latter in 1903, and both having been issued many years before the presence of the Ames, Pine Creek, and Brush Creek fossiliferous zones had been determined in sufficient detail in the Potomac Valley to make certain the correlation of the Conemaugh and Allegheny coals. The work of the last few years by members of both Surveys makes necessary a drastic revision of the nomenclature in this boring.

The section as herein presented shows a portion of the Conemaugh Series in which the Upper Bakerstown Coal of the Piedmont and Blaine regions has now disappeared, and gives the entire Allegheny Series with several of its coals represented, and passes through 170 feet of the Pottsville Series in which the coals of the Mercer stage, including the Tionesta, Upper Mercer, and Lower Mercer, are all represented. A most interesting feature in the record is the presence of 2 inches of black flint, noted by the driller a few feet above the Lower Mercer Coal and coming at the exact horizon where the writer has always contended that the Kanawha Black Flint of southern West Virginia belongs, although the actual flint has never been found at outcrop northeast of northern Nicholas County, and its fossils, which persist in the black shale that replaces the flint, have not been certainly identified northeast of southern Upshur County, one exposure of a similar fauna on the western slope of Laurel Ridge in eastern Barbour, that could not be definitely assigned to its horizon for lack of supporting stratigraphic evidence, having been noted. It is not known that a critical examination of the core at the Henry boring was ever made and such would hardly be possible at this late date, owing to its probable destruction, but it is not impossible that the flint might recur even at this distance from its area of normal development. It was long ago assumed by Dr. I. C. White and Dr. David White that the Kanawha Black Flint belonged somewhere in the Mercer stage and the much more recent work of the writer has seemed to place it just above the Lower Mercer Coal, making this coal apparently correlate with the Stockton of the Great Kanawha region. The section is as follows:

Henry Section, Union District.

Record of

Davis Coal & Coke Company No. 73 Coal Test Boring (74).

Union District; on North Branch of Potomac River at Henry; authority, Davis Coal & Coke Company; completed, July 15, 1892; elevation, 2641′ L.

	Thickness. Ft.	In.	Total. Ft.	In.	Interval. Ft.	In.
Conemaugh Series (382′ 10½″)						
Clay, wash, and sand	23	2	23	2		
Clay, blue	2	0	25	2		
Sandstone, fine, dark	1	4½	26	6½		
Fire clay, dark	4	2	30	8½		
Limestone, blue	2	11	33	7½		
Fire clay, dark, hard	5	0	38	7½		
Fire clay, sandy	1	5½	40	1		
Fire clay, soft	2	8½	42	9½		
Fire clay, blue, medium-hard	25	0	67	9½		
Coal, very bony and slaty, Harlem	1	6½	69	4	69	4
Slate, black, bony	2	6½	71	10½		
Fire clay, light	4	1½	76	0		
Fire clay, light, sandy	9	8	85	8		
Sandstone, hard, gray, **Jane Lew**	6	7½	92	3½		
Rock, sandy, streaks of **coal**	0	10	93	1½		
Slate, black, bony	1	5	94	6½		
Saltsburg Sandstone:						
Sandstone, hard, dark..0′ 4½″ Sandstone, hard, conglomerate .....5 4½ Fire clay, light, soft ....3 2½ Sandstone, dark 1 1	10	0½	104	7		
Fire clay, soft, light	1	5	106	0		
Fire clay, light, streaks of bone, **Upper Bakerstown Coal horizon**	15	3½	121	3½	51	11½
Slate, shelly, bony	1	2	122	5½		
Fire clay, light, hard	8	3	130	8½		
Fire clay, light, sandy	5	1½	135	10		
Fire clay, dark, sandy	11	11	147	9		
Sandstone, dark ....13′ 2½″ Sandstone, light, hard .....19 2 Sandstone, dark, hard ..... 0 11 } Thomas	33	3½	181	0½		
Bakerstown ("Thomas") Coal:						
Coal, bony, slaty .....1′ 10″ **Coal**, good 3 4	5	2	186	2½	64	11
Slate, black	1	5	187	7½		
Fire clay	0	9½	188	5		
Limestone, **Albright, or Pine Creek?**	0	11½	189	4½		
Fire clay, black	6	9	196	1½		
Fire clay, light	0	7½	196	9		

	Thickness. Ft.	In.	Total. Ft.	In.	Interval. Ft.	In.
Buffalo Sandstone:						
Sandstone, fine, light, streaks of slate 10′ 3″ Sandstone, hard, gray 13 3 Sandstone, conglomerate 1 7½ Sandstone, hard, gray, streaks of conglomerate 4 8 Sandstone, hard, gray, flinty 0 8 Fire clay, light, streaks of sandstone 13 3 Sandstone, blue 16 1 Sandstone 1 4	61	1½	257	10½		
Fire clay, **Brush Creek Coal horizon**	2	0	259	10½	73	8
Sandstone, streaks of fire clay	21	3	281	1½		
Fire clay, dark	11	10½	293	0		
Fire clay, light	3	2½	296	2½		
Upper Mahoning Sandstone:						
Sandstone, light 19′ 8″ Sandstone, streaks of fire clay 5 2	24	10	321	0½		
Bone	0	2	321	2½		
Fire clay	3	0	324	2½		
Sandstone	1	10	326	0½		
Fire clay	1	1	327	1½		
Limestone, **Sutton**	1	0	328	1½		
Fire clay, hard streaks	16	3	344	4½		
Mahoning ("Six-foot") Coal horizon: Slate, black, and bone 0′ 6″ Slate, black 0 7	1	1	345	5½	85	7
Fire clay, dark	10	5	355	10½		
Fire clay, light	1	1½	357	0		
Sandstone, streaks of fire clay						
Lower Mahoning	14	5½	371	5½		
Slate, dark	3	1½	374	7		
Fire clay, streaks of sandstone	3	8	378	3		
Sandstone	2	3½	380	6½		
Slate, black, **Uffington**	2	4	382	10½		
Allegheny Series (147′ 10″)						
Coal, bone 0′ 2″ Slate 0 1 **Coal** 2 7½ Slate 0 5 Bone 0 7 **Coal** 2 0 Slate 0 1½ **Coal** 2 3 — **Upper Freeport ("Split-Six," "Davis")**	8	3	391	1½	45	8
Fire clay, dark	6	0½	397	2		
Fire clay, streaks of slate	13	2	410	4		
Slate, bony, and **coal**	2	1½	412	5½		
Fire clay, light	7	6	419	11½		

	Thickness. Ft.	In.	Total. Ft.	In.	Interval. Ft.	In.
Upper Freeport Sandstone:						
Sandstone, streaks of slate ....3′ 9½″ Sandstone, white....0 2½	4	0	423	11½		
Lower Freeport Coal horizon:						
Slate, black ....4′ 5″ Slate and bone 0 7½	5	0½	429	0	37	10½
Lower Freeport Fire Clay:						
Fire clay, light ....2′ 0″ Fire clay, dark 4 5	6	5	435	5		
Sandstone, hard, white	2	8	438	1		
Fire clay, dark	4	5½	442	6½		
Fire clay, dark, hard	0	4½	442	11		
Fire clay, streaks of sandstone	8	3	451	2		
Lower Freeport Sandstone:						
Sandstone, hard, flinty ....13′ 0 ″ Sandstone, conglomerate .... 7 4½ Sandstone, hard, gray, flinty .... 0 4 Fire clay, hard, dark 0 6½ Sandstone, hard, gray, flinty 5 0½	26	3½	477	5½		
Fire clay, streaks of sandstone, **Upper Kittanning and Hardman Fire Clays**	20	8½	498	2		
Sandstone, streaks of fire clay	1	8½	499	10½		
Fire clay	0	6½	500	5		
Upper East Lynn Sandstone:						
Sandstone, hard ....2′ 1″ Fire clay ....0 1½ Sandstone, hard ....5 6 Sandstone, fine, dark 0 8	8	4½	508	9½		
Fire clay	1	2	509	11½		
Middle Kittanning Coal:						
Coal, sulphurous ....0′ 3 ″ **Coal** ....0 8 Slate ....0 0½ **Coal** 0 6	1	5½	511	5	82	5
Sulphur and slate	0	1	511	6		
Fire clay	10	2	521	8		
Bone	0	1½	521	9½		
Lower Kittanning Coal:						
Coal ....1′ 3½″ Fire clay ....0 8½ Bone ....0 2½ Slate and bone ....0 5½ **Coal**, streaks of sulphur 0 8	3	4	525	1½	13	8½
Fire clay, **Lower Kittanning**	4	7½	529	9		
Sandstone	0	5	530	2		
Fire clay, sandy	0	6½	530	8½		

	Thickness. Ft.	In.	Total. Ft.	In.	Interval. Ft.	In.
Pottsville Series (170′ 8½″)						
Homewood Sandstone:						
Sandstone, hard, gray ... 7′ 1″						
Fire clay, sandy ... 0 7						
Sandstone, hard, gray ... 16 9½						
Conglomerate ... 1 8½						
Sandstone, hard, gray ... 8 11½						
Fire clay, sandy ... 1 4						
Sandstone, hard, gray ... 4 10	59	3	589	11½		
Sandstone, fine, gray ... 9 1						
Fire clay ... 1 0						
Sandstone, hard, gray ... 1 8						
Fire clay, sandy ... 1 1						
Sandstone, hard, gray ... 1 7						
Fire clay ... 1 6½						
Sandstone ... 2 0						
Slate, black	3	2½	593	2		
Bone ... 0′ 2″ / Coal, streaks of sulphur ... 1 0 — Tionesta	1	2	594	4	69	2½
Slate, black	3	0	597	4		
Mount Savage Fire Clay:						
Fire clay, light ... 1′ 0″						
Fire clay, dark ... 0 3						
Fire clay, streaks of bone ... 0 7						
Fire clay, light ... 10 7½	23	0½	620	4½		
Fire clay, sandy ... 2 7						
Fire clay ... 8 0						
Coal, slaty, Upper Mercer	1	3	621	7½	27	3½
Fire clay	3	2	624	9½		
Black flint, **Kanawha Black Flint**	0	2	624	11½		
Slate, black	5	7	630	6½		
Lower Mercer (Stockton) Coal:						
Coal, slaty ... 0′ 8½″						
Bone ... 0 1½	1	2½	631	9	10	1½
Coal ... 0 4½						
Slate, black	0	4½	632	1½		
Fire clay	2	7½	634	9		
Upper Connoquenessing Sandstone:						
Sandstone, hard, dark ... 18′ 0½″						
Sandstone, hard, gray ... 30 10½						
Fire clay ... 0 3½						
Sandstone, hard, gray ... 4 10	66	8	701	5		
Sandstone, hard, blue ... 1 6						
Fire clay ... 2 0						
Sandstone, hard, gray ... 9 1½						

The following section is the record of another boring near Wilsonia and continues the succession of the lower portion of the Conemaugh Series along the Potomac Valley, the disappearance of the Upper Bakerstown and Mahoning Coals as commercial beds being well exhibited:

Wilsonia Section, Union District.
Record of
Davis Coal & Coke Company No. 62 Coal Test Boring (85).

Union District; on North Branch of Potomac River, 1.2 miles northeast of Kempton; authority, Davis Coal & Coke Company; completed, February 22, 1913; elevation, 2701′ L.

	Thickness.		Total.		Interval.	
	Ft.	In.	Ft.	In.	Ft.	In.
Conemaugh Series (457′ 10″″)						
Clay, yellow	9	0	9	0		
Sand	21	0	30	0		
Gravel	7	0	37	0		
Shale, gray	2	0	39	0		
Shale, gray, broken	29	0	68	0		
Shale, gray	10	0	78	0		
Shale, red	5	0	83	0		
Shale, mixed, blue and gray	7	0	90	0		
Shale, sandy	3	0	93	0		
Sandstone, **Grafton**	12	0	105	0		
Shale, sandy	4	0	109	0		
Shale, gray	16	0	125	0		
Coal, Harlem	1	4	126	4	126	4
Shale, limy	11	8	138	0		
Shale, soft, limy, with hard bands	4	0	142	0		
Shale, broken, red	15	0	157	0		
Limestone, **Ewing**	4	0	161	0		
Shale, red	2	0	163	0		
Shale, hard, limy	6	0	169	0		
Shale, gray	3	0	172	0		
Shale, red and blue	3	0	175	0		
Shale, gray	10	0	185	0		
Sandstone, with shale bands	3	0	188	0		
Shale, mixed	4	0	192	0		
Shale, gray	3	0	195	0		
Sandstone	3	0	198	0		
Shale, gray	2	0	200	0		
Shale, dark	1	6	201	6		
Shale, dark, with **coal** partings, **Upper Bakerstown Coal**	1	6	203	0	76	8
Sandstone	3	0	206	0		
Shale, broken, limy	13	0	219	0		
Sandstone	6	0	225	0		
Shale, limy	9	0	234	0		
Shale, gray	5	0	239	0		
Sandstone	2	0	241	0		
Shale, sandy	2	0	243	0		
Sandstone	1	0	244	0		
Shale, blue	6	0	250	0		
Shale, dark	4	0	254	0		
Fire clay, mixed with sandstone	15	0	269	0		

	Thickness. Ft.	In.	Total. Ft.	In.	Interval. Ft.	In.
Thomas Sandstone:						
Sandstone, with shale, mixed ..... 4 0"						
Sandstone 10 0	14	0	283	0		
Shale, with sandstone bands	6	0	289	0		
Shale, sandy	10	0	299	0		
Sandstone	15	0	314	0		
Shale, dark, with yellow bands	5	0	319	0		
Shale, black	4	0	323	0		
Sandstone, **Buffalo**	16	0	339	0		
Slate, **Brush Creek**	1	0	340	0		
Brush Creek Coal:						
Bone coal .....0' 4"						
Slate 0 6						
Coal 0 7	1	5	341	5	138	5
Upper Mahoning Sandstone:						
Sandstone .....11' 7"						
Sandstone, with shale bands 13 0						
Sandstone 1 0						
Shale, dark 3 0						
Sandstone 21 0	49	7	391	0		
Shale, red and gray, **Mahoning**	7	0	398	0		
Sandstone	6	0	404	0		
Shale, dark	2	0	406	0		
Sandstone, with shale bands	8	0	414	0		
Slate, dark	2	0	416	0		
Shale, gray	4	0	420	0		
Shale, tough, with hard bands	6	6	426	6		
Mahoning ("Six-foot") Coal:						
Coal .....0' 3"						
Bone coal, mixed with shale 0 6	0	9	427	3	85	10
Shale, gray	2	9	430	0		
Shale, sandy	27	0	457	0		
Slate	0	10	457	10		
Allegheny Series (15' 2")						
Upper Freeport ("Split-six," "Davis") Coal:						
Coal .....0' 6"						
Slate 0 2						
Coal 0 2						
Slate 0 2						
Coal 2 3						
Slate 0 1						
Coal 1 11						
Shale, dark, sticky 1 3						
Bone coal 0 2	6	8	464	6	37	3
Fire clay	2	0	466	6		
Shale, sandy, gray, to bottom	6	6	473	0		

In the following section arranged in descending order, the surface portion, Nos. 1-31, was measured with hand-level and starts at the top of Fairfax Knob just southeast of the common corner of Tucker, Preston, Grant, and Garrett

Counties, the first 134 feet of strata, Nos. 1-22, being exposed southeast of the knob toward Fairfax Summit, approximately on the line between Tucker and Grant Counties. The next 154 feet, Nos. 23-31, were secured northeast of the knob, with a careful check measurement to the Pittsburgh Coal to avoid duplication of strata. The coal which appears at 200 feet has been provisionally correlated with the Upper Hoffman of the Maryland Survey, which seems to be represented by the infrequent Normantown Coal of West Virginia west of this point, its identification necessarily being subject to much doubt. The subsurface portion of the section is the record of the Davis Coal & Coke Company No. 48 Coal Test Boring (No. 93 on Map IV), located 0.3 mile northeast of the knob, which starts at the base of the hand-leveled measurement. Being near the center of the basin where there is only a slight dip, the section shows approximately true vertical intervals. The same section has been previously described in the Tucker County Report of the Survey, pages 130-131:

Fairfax Section, Union District.

	Thickness. Ft.	In.	Total. Ft.	In.	Interval. Ft.	In.
Monongahela Series (56′)						
1. Sandstone, gray, Upper Pittsburgh, and concealed, from top of Fairfax Knob	36	0	36	0		
Pittsburgh "Rider" Coal, Davis Coal & Coke Co., Exposure (No. 5A on Map IV):						
2. Coal 0′ 10″						
3. Shale 1 3	2	4	38	4		
4. Coal 0 3						
5. Shale, gray	5	3	43	7		
Pittsburgh Coal, (3197′ L.), Davis Coal & Coke Co., Mine (No. 35 on Map IV):						
6. Coal 0′ 6″						
7. Shale, gray 0 2						
8. Coal 9 9	12	5	56	0	56	0
9. Shale, gray 1 0						
10. Coal 1 0						
Conemaugh Series (838′ 6½″)						
11. Concealed	6	0	62	0		
12. Limestone, Fairfax	2	0	64	0		
13. Concealed	2	8	66	8		
14. Coal, Morantown (of Maryland Survey), fallen shut (3182′ L.) Davis Coal & Coke Company Mine (No. 38 on Map IV), reported	4	4	71	0	15	0

	Thickness. Ft.	In.	Total. Ft.	In.	Interval. Ft.	In.
15. Concealed	46	0	117	0		
16. Sandstone and sandy shale, Lower Pittsburgh	9	1	126	1		
17. Shale, dark, with coal streaks	1	6	127	7		
Little Pittsburgh Coal, (3119′ L.), Davis Coal & Coke Co. Mine (No. 41 on Map IV):						
18. Coal, hard 0′ 8″						
19. Shale, dark 1 8						
20. Coal, good, soft 3 0	6	5	134	0	63	0
21. Shale, gray 0 6						
22. Coal 0 7						
23. Concealed	19	0	153	0		
24. Shale, gray, sandy	15	0	168	0		
25. Shale, dark, with plant fossils	4	8	172	8		
Coal, Little Clarksburg, ("Franklin" "Dirty Nine-foot") Davis Coal & Coke Company Exposure (No. 58 on Map IV) as follows:						
26. Coal 1′ 0″						
27. Slate, dark 0 1	1	4	174	0	40	0
28. Coal 0 3						
29. Shale, gray and concealed	26	0	200	0		
30. Coal opening, fallen shut, not much found?, Normantown (Upper Hoffman?), Davis Coal & Coke Company Exposure (No. 62 on Map IV)	....	....	200	0	26	0
31. Concealed	88	0	288	0		
Continued by the Davis Coal & Coke Company Core Test No. 48 (No. 93 on Map IV), (2966′ L.):						
32. Sand and gravel	23	0	311	0		
33. Shale, gray, broken	23	0	334	0		
34. Shale, red, broken	10	0	344	0		
35. Shale, blue	43	0	387	0		
36. Shale, gray	2	0	389	0		
37. Shale, red	4	0	393	0		
38. Shale, gray, hard	28	0	421	0		
39. Shale, blue	23	0	444	0		
40. Shale, muddy	10	0	454	0		
41. Shale, dark	10	0	464	0		
42. Shale, black	3	6	467	6		
43. Coal, Elk Lick ("Four-foot," "Barton")	0	4	467	10	267	10
44. Slate, dark	3	2	471	0		
45, Shale, gray 32′ 0″						
46. Shale, blue 10 0						
47. Shale, red 3 0 Birmingham	67	0	538	0		
48. Mud shale 22 0						
49. Sandstone, Grafton	4	0	542	0		
50. Shale, gray	10	0	552	0		

		Thickness.		Total.		Interval.	
		Ft.	In.	Ft.	In.	Ft.	In.
51. Slate, black, **Ames**		17	0	569	0		
52. **Coal, Harlem**		1	6	570	6	102	8
53. Slate, black .. 2′ 6″							
54. Shale, gray .. 8 0							
55. Shale, gray, broken 20 0	Pittsburgh Reds	81	6	652	0		
56. Shale, red 5 0							
57. Sand shale 9 0							
58. Shale, gray .. 29 0							
59. Shale, red 8 0							
60. Shale, gray		22	0	674	0		
61. Sandstone, **Saltsburg**		10	0	684	0		
62. Shale, gray, horizon of **Bakerstown ("Thomas") Coal**		27	0	711	0	140	6
63. Shale, broken		24	0	735	0		
64. Sandstone, **Buffalo**		7	0	742	0		
65. Shale, gray		17	0	759	0		
66. Sand shale		10	0	769	0		
67. Slate, black, **Brush Creek**		13	0	782	0		
68. **Coal, Brush Creek**		1	8	783	8	72	8
69. Slate, dark		2	4	786	0		
70. Shale, gray		9	0	795	0		
71. Sandstone, **Upper Mahoning**		20	0	815	0		
72. Shale, gray		20	0	835	0		
73. Sand shale		25	0	860	0		
74. Sandstone, very hard, **Lower Mahoning**		8	0	868	0		
75. Shale, gray .. 9′ 0″							
76. Slate, dark 3 0	Uffington Shale	26	6½	894	6½		
77. **Coal** 0 6							
78. Slate, black .. 1 6							
79. Slate, dark 12 6½							
Allegheny Series (22′ 11″)							
80. **Coal** ....2′ 1″							
81. Binder 0 1½							
82. **Coal** 3 1	Coal, Upper Freeport ("Split-six," "Davis")	14	11½	909	6	125	10
83. Slate 2 9							
84. **Coal** 4 4½							
85. Slate ..2 0½							
86. **Coal** 0 6							
87. Slate, gray		7	11½	917	5½		

SUMMARY OF MEASURED SECTIONS.

For convenient reference the thickness of the stratified rocks of Mineral and Grant Counties, as determined by the measured sections in this Chapter, is compiled in the following table, showing not only the thicknesses of the various series but also the totals for the different Periods down to the lowest depths to which there are exposures. A line of dots (.....) under a series indicates that it was not exposed, or in some cases not examined, where the section was measured. A question mark (?) indicates that the series was pres-

Photo by E. E. HARRIS.

PLATE IX.—Fire Station on top of Pinnacle Triangulation Point on Allegheny Front. The sandstone is a Pottsville member, probably Upper Connoquenessing.

ent and was examined but could not be differentiated from the one overlying or the one below it. A plus mark (+) indicates that only a portion of the full series or period is included in the section. In some cases a section shows a thickness of a series either too great or too small, owing to the dip of the measures where it was made, a reduction to true vertical measurement being impracticable at some points in the Pennsylvanian, but as far as possible such places were avoided. In the steeply dipping rocks east of the Allegheny Front, however, all sections were reduced to true vertical measurement and so published. An explanation accompanies each section, where published in the text, detailing the conditions under which it was made:

Table Showing Thickness of Stratified Rocks in Measured Sections of Mineral and Grant Counties.

Place Measured.	Pennsylvanian.					Mississippian.				Devonian.								
	Monongahela.	Conemaugh.	Allegheny	Pottsville.	Total.	Mauch Chunk.	Greenbrier.	Pocono.	Total	Catskill	Chemung.	Portage.	Genesee.	Hamilton.	Marcellus.	Oriskany.	Helderberg.	Total.
Barnum		425 +	50+		475+													
Bayard		385 +			385+													
Bloomington		559½ +	120½ +		680+													
Bond			171 +	459	630+													
Cedar Cliff																	469	469+
Claysville										2417	1424	2058	?	?	503	50+		7172+
Dobbin		451 +	10 +		461+													
Elk Garden	171+	751	174		1096+													
Fairfax	56+	838	23 +		917+													
Falls																75+	976	1051+
Gleason		676 +	206	28+	910+													
Hampshire	110+	800	15 +		925+													
Henry		383 +	148 +	170+	701+													
Hopeville																		
Howell Run		790 +			790+													
Hubbard		312 +	198	170+	680+													
Keyser						827	273	596	1696	1925	4047	689+						6661+
Knobly												1780	313					2093+
Limestone Run																194	356	550+
Luke	17+	777	148	65+	1007+													
Maysville													?	?	835	215	?	?
Piedmont	115+	818	182	95+	1210+													
Potomac																?	?	550+
Ridgeville													?	?	573			1476+
Schell		573 +	222	80+	875+													
Shaw	105+	904 +			1009+													
Westernport		85 +	127	383	595+													
Wilson		693 +	10 +		703+													
Wilsonia		458 +	15 +		473+													

Table Showing Thickness of Stratified Rocks in Measured Sections of Mineral and Grant Counties (Continued).

Place Measured.	Silurian.									Ordovician.		Total Section.
	Bossardville.	Rondout.	Bloomsburg.	Niagara.	Clinton	White Medina.	Red Medina.	Gray Medina.	Total.	Martinsburg.	Total	
Barnum												475
Bayard												385
Bloomington												680
Bond												630
Cedar Cliff	463	409							872+			1341
Claysville												7172
Dobbin												461
Elk Garden												1096
Fairfax												917
Falls	210	647	105	291	629	317	745+		2944+			3995
Gleason												910
Hampshire												925
Henry												701
Hopeville						300	1015	254	1569+	296+	296+	1865
Howell Run									+?			790
Hubbard												680
Keyser												8357
Knobly												2093
Limestone Run	234	292+							526+			1076
Luke												1007
Maysville	?	?	10	161	312	212			?			3238
Piedmont												1210
Potomac	?	?	68	100	655+				1683+			2233
Ridgeville												1476
Schell												875
Shaw												1009
Westernport												595
Wilson												703
Wilsonia												473

CHAPTER VI.

STRATIGRAPHY---MONONGAHELA SERIES.

GENERAL ACCOUNT AND SECTION, MONONGAHELA SERIES.

The Monongahela Series, of the Pennsylvanian Period, is represented in Mineral and Grant Counties only by certain isolated deposits along the North Potomac (Georges Creek) Syncline and in the Stony River Basin which branches from the former in the vicinity of Barnum and Shaw. In the Monongahela Valley of northern West Virginia and western Pennsylvania this series attains a maximum thickness of slightly more than 400 feet, but in the counties under discussion only 175 to 180 feet of the lower portion has escaped erosion. Farther north in the Georges Creek Basin of Maryland and Pennsylvania, however, the full series is reported to be present, making it seem quite probable that the upper portion was also represented south of the Maryland Line, the total thickness being probably much the same as in the Monongahela Valley, or perhaps slightly greater.

The lower half which now remains is composed of alternate sandstones (41.67 per cent.), sandy shales (42.22 per cent.), and coals (15.55 per cent.), with a very small percentage of limestone (0.56), as illustrated by the following general section compiled in descending order:

General Section of the Monongahela Series for Mineral and Grant Counties.

	Thickness. Feet.	Total. Feet.
Sandstone, Sewickley, massive, gray, coarse, 30′ to	40	40
Shale, sandy, 1′ to	4	44
Coal, Sewickley, ("Tyson"), medium-soft, double-bedded, 4′ to	6	50
Shale, sandy, 0′ to	5	55
Limestone, Sewickley, gray, hard, non-marine, lenticular, 0′ to	1	56

	Thickness. Feet.	Total. Feet.
Shale, sandy, with streaks of sandstone	40	96
Sandstone, Cedarville, shaly, 10′ to	20	116
Coal, Redstone, medium-soft, poorly exposed, 2′ to	4	120
Shale, sandy	12	132
Sandstone, Pittsburgh, coarse and soft, much weathered at all outcrops, lenticular, 5′ to	15	147
Shale, sandy, 5′ to	10	157
Coal, Pittsburgh "Rider," soft, double- or multiple-bedded, lenticular, 0′ to	3	160
Shale, sandy, 0′ to	5	165
Coal, Pittsburgh, ("Big Vein"), soft, double- or multiple-bedded, 10′ to	15	180

TOPOGRAPHIC EXPRESSION, MONONGAHELA SERIES.

Owing to the small amount of Monongahela sediments still remaining in the Potomac Valley no definitely characteristic topography is maintained. In localities where the Sewickley Sandstone is present there is usually a flat tableland at the top, the slopes below being littered with talus from the ledge, followed by smoothly sloping ground to the base of the series, the whole of which rests upon a much more conspicuous plateau formed by the massive sandstone members of the upper portion of the Conemaugh Series. At many points, however, the Sewickley stage is completely eroded, leaving only small hillocks or low, smooth ridges containing the Pittsburgh Coal and the sandy shales and thin sandstones that belong in the zone immediately above it.

AREAL EXTENT, MONONGAHELA SERIES.

As implied above, the remnants of the Monongahela Series are so fragmentary that they comprise only a small fraction of the outcropping rocks of the two counties, their total extent as measured by planimeter, being only 3.13 square miles. As shown by Maps II and IV most of these deposits are in Mineral County between Piedmont and the Grant County Line along the axes of the main North Potomac Syncline and the Stony River Basin farther south. In Grant County there is none of this series present in the Stony River Basin and in the North Potomac depression only two small summits at the headwaters of the river contain it.

CONTACTS, MONONGAHELA SERIES.

Owing to the total erosion of Dunkard (Premo-Carboniferous) rocks, as well as the upper portion of the Pennsyl-

vanian, in the two counties, no opportunity of observing the important upper contact of the Monongahela Series is afforded. At its base it rests in apparent conformity upon the upper members of the Conemaugh Series, there being no known faunal or floral distinctions to mark the change. This contact, as originally drawn by H. D. Rogers, was established on the basis of a supposed transition from an upper group rich in minable coals to a lower series largely barren of this economic substance, but in the Potomac, as well as in various other regions, such a distinction does not hold good, as there are several important coal beds in the Conemaugh. There is in general, however, a much larger percentage of red shale in the upper portion of the Conemaugh than in the Monongahela, but this is a distinction of degree rather than of complete change. The inference is therefore quite apparent that the junction of the two series is an arbitrary line that has been preserved through many years because of its historical use in early reports rather than because of paleontologic or stratigraphic merit. Dr. White[1] has even gone so far as to state a belief that the base of the Permian could quite properly be put at the base of the lowest red beds of the Conemaugh Series, and such a division would necessarily include all of the Monongahela as well as more than half of the Conemaugh, there being both vertebrate and invertebrate, as well as floral, evidence in support of such an interpretation.

FOSSIL LIFE, MONONGAHELA SERIES.

The Monongahela Series, so far as known, is totally devoid of marine fauna, but in the Monongahela Valley some of its limestones contain fresh-water organisms. No fossils were observed in Grant and Mineral Counties where limestones are seldom found in the series, although a more patient search might reveal them. The series is rich in plant remains, however.

DESCRIPTION OF MEMBERS, MONONGAHELA SERIES.

SEWICKLEY SANDSTONE.

The **Sewickley Sandstone,** lying almost immediately over the Sewickley Coal, is the highest stratum of the Mononga-

[1] I. C. White, Braxton and Clay Report, W. Va. Geological Survey, pp. 822-829; 1917.

hela Series now remaining in the two counties. At the few points where it is found it is usually hard and quite durable, of massive bedding, gray in color, quite coarse in texture, and somewhat conspicuous in appearance owing to the talus which falls from it to the slopes below. In Grant County it is entirely eroded, but in Mineral it is noted in the Piedmont Section, page 155, as being approximately 30 feet thick; in the Hampshire Section, page 163, as 30 feet, and in the Elk Garden Section, page 168, as 40 feet. So far as known it has not been quarried, owing to its isolated position in the hill-tops, but it would make a fair grade of building stone where massive masonry is desired.

SEWICKLEY ("TYSON") COAL.

The **Sewickley Coal,** coming under the Sewickley Sandstone, from which it is usually separated by a thin bed of shale, and being approximately 120 to 130 feet above the base of the Pittsburgh Coal, is a persistent and valuable bed at the few points where its horizon outcrops in Mineral County, but in Grant it belongs entirely above the present topography. In the Potomac Valley it is popularly known as the **"Tyson"** seam but there appears to be little doubt as to its correlation with the true Sewickley Coal of western Pennsylvania and northern West Virginia. At the only opening where it is now fully exposed in the area of this Report it is medium-soft and double-bedded, with a small shale parting near the base. Judging from this opening and from other reports it appears to vary from 4 to 6 feet in thickness. Its outcrop is shown on Map II and in Chapter XVII its character, extent, chemical quality, and section will be presented under the subject of "Commercial Coal."

SEWICKLEY LIMESTONE.

The **Sewickley Limestone,** coming a few feet under the Sewickley Coal, was noted only in the top of a high ridge, 0.7 mile northeast of Elk Garden, Mineral County, where a few boulders are present, as indicated in the Shaw Section, page 166. It does not appear to be more than one or two feet in thickness. Owing to its fresh-water origin it is of small scientific interest and because of its limited occurrence it has no economic importance.

CEDARVILLE SANDSTONE.

The **Cedarville Sandstone,** coming just over the Redstone Coal, was noted only in the Elk Garden Section, page 168,

where it is 10 feet thick and poorly exposed. In the counties of the State farther west where it frequently outcrops it is usually shaly and unsuitable for use as a building stone.

REDSTONE COAL.

The **Redstone Coal,** belonging 65 to 75 feet below the Sewickley Coal and 50 to 65 feet above the base of the Pittsburgh seam, is a bed that has apparently been neglected in the economic exploitation of the Potomac Valley and is therefore poorly exposed and of somewhat uncertain character. In Grant County its horizon is above the hilltops but in Mineral it should be present in all the ridges where the Sewickley occurs, as well as in certain others that do not extend quite up to the latter bed. In the section for Elk Garden, page 168, is noted as being 4 feet thick at outcrop in the public road and its presence is also noted in the Piedmont Section, page 155. From its outcrop at Elk Garden it appears to be of sufficient thickness to class it as a minable coal and its further discussion will be presented in Chapter XVII under the subject of "Commercial Coal."

PITTSBURGH SANDSTONE.

The **Pittsburgh Sandstone,** usually coming 5 to 15 feet above the top of the Pittsburgh Coal, and often being a massive and conspicuous ledge in more western counties, is but poorly represented in Mineral and Grant, its horizon being usually occupied by sandy shales with occasional lenses of soft stone which are easily removed by steam shovel at various stripping operations in the Pittsburgh Coal beneath it. In the section for Elk Garden, page 168, its presence is noted at an imperfect exposure and in the section for Fairfax, page 190, it is also recorded as present in the top of Fairfax Knob but too poorly exposed to afford a measurement of its thickness. In other counties where it is better developed it is typically a coarse, soft, grayish-white stratum, poorly cemented and largely unfit for masonry or other economic use and a similar character is indicated by the extremely limited outcrops along the Potomac.

PITTSBURGH "RIDER" COAL.

The **Pittsburgh "Rider" Coal,** coming a few feet above the top of the Pittsburgh bed, from which it is separated by sandy shale, is a lenticular deposit that has apparently been noted only in the Potomac Valley, being a double- or multiple-bedded seam with no probable economic value. In

Mineral County it was observed only in the roof shales of the Pittsburgh Coal in the top of Shores Knob, 1.8 miles east of Shaw, Elk District, where there is 8′ 6″ of intermingled coal and sandstone, coming 10 feet above the top of the Pittsburgh, as recorded in the section of the **H. P. Brydon and Bro., Inc., Mine (No. 13 on Map II)** in the latter seam. In Grant County it is noted in the Fairfax Section, page 190 where it is 2′ 4″ thick with a large central shale parting at the **Davis Coal & Coke Company Prospect (No. 5A on Map IV)** in the top of Fairfax Knob at the extreme head of North Branch of Potomac River, this being the point of its original description by the writer in the Tucker County Report of the Survey. This coal is of scientific interest only, as it is too impure and lenticular to have economic value.

PITTSBURGH ("BIG VEIN") COAL.

The **Pittsburgh Coal,** known widely among operators and miners of the Potomac region as the **"Big Vein"** because of its exceptional thickness, is the basal and most important member of the Monongahela Series in Grant and Mineral Counties as well as in nearly all other regions where the series is present. Owing to its great purity and yield per acre this coal has been so intensively mined that only a few acres now remain in the two counties, the original amount having embraced several hundred. In the few localities where an undisturbed section may now be seen the coal is quite soft and invariably contains one shale parting and sometimes two, the total thickness varying from 10 to 15 feet. There is reliable evidence, however, to the effect that a few openings, long since abandoned and fallen shut, exhibited an extreme thickness of more than 20 feet. The outcrop of this coal is shown on Maps II and IV and in Chapter XVII detailed sections, chemical analyses, estimates of tonnage, and other economic data will be presented under the subject of "Commercial Coal."

ECONOMIC ASPECTS, MONONGAHELA SERIES.

From an economic standpoint the Monongahela Series is of value because of its commercial coal beds of which there are three, as already mentioned. So far as known it has no other mineral substances of value in the two counties other than its shales which produce good agricultural soils when disintegrated.

CHAPTER VII.

STRATIGRAPHY---CONEMAUGH SERIES.

GENERAL ACCOUNT AND SECTION, CONEMAUGH SERIES.

The Conemaugh Series, of the Pennsylvanian Period, comprises a very considerable portion of the outcropping rocks west of the Allegheny Front in both Mineral and Grant Counties, as well as in the adjoining counties of Allegany and Garrett, Maryland, on the northern side of the Potomac River. This river for many miles has cut a deep channel through these rocks, affording an excellent opportunity for detailed study and vertical measurement both along the parent stream and its tributaries, and the presence of several valuable beds of coal in the series has caused extensive prospecting to be done both by drift and by diamond drill so that an unusual amount of precise data is available. As detailed by the measured sections of Chapter V the series varies in thickness from 777 feet at Luke, near Piedmont, to 838 feet at Fairfax on the headwaters of North Branch of the Potomac, so that its average for the entire area may be considered roughly as 800 feet, as compared to an average of 600 to 625 feet in western Pennsylvania and the more central counties of northern West Virginia. The additional thickness along the Potomac is accounted for by additional beds of sandstone, shale, and coal, rather than by thickening of individual members, and the introduction of these new beds seems to have occurred as interjections in the shales of the series instead of by splits or partitions of the sandstones and coals. More properly speaking, the Conemaugh sediments derived from the ancient mountain masses of Appalachia and carried westward by primeval rivers had their apparent maximum development in the Potomac region and some of the sand sheets with attendant coal swamps did not reach far out into the Appalachian Sea, and as the study of these deposits began in western Pennsylvania several members of the

Potomac phase, because of their total absence, were not observed and not recorded by Lesley, Stevenson, White, and others who made these investigations.

The following general section, compiled mainly from the detailed measurements of Chapter V, as well as from other observations and borings, indicates the nature and succession, in descending order, of the Conemaugh Series of the two counties, being the same, with minor revisions and corrections, as that published by the writer in the Tucker County Report of the Survey where a much less satisfactory opportunity to study these beds was afforded. In lithological character the series is composed approximately of 36.25 per cent. of sandstone, 55.38 per cent. of shale, 6.50 per cent. of coal, and 1.87 per cent. of limestone:

General Section of the Conemaugh Series for Mineral and Grant Counties.

	Thickness. Feet.	Total. Feet.
Coal, Pittsburgh, basal member of Monongahela Series	....	.....
Fire clay and shale	5	5
Limestone, Fairfax, lenticular, fresh-water origin, 0′ to	2	7
Shale	8	15
Coal, Morantown, lenticular, and impure, multiple-bedded, 1′ to	5	20
Shale	35	55
Sandstone, Lower Pittsburgh, shaly, 5′ to	10	65
Shale, dark	4	69
Coal, Little Pittsburgh, multiple-bedded, lenticular, 1′ to	6	75
Shale, sandy	29	104
Coal, Second Little Pittsburgh, lenticular, 0′ to	1	105
Shale, sandy	4	109
Sandstone, Connellsville, brown, massive, 10′ to	20	129
Coal, Franklin "Rider," lenticular, 0′ to	1	130
Shale, sandy	13	143
Coal, Little Clarksburg, "Franklin," "Dirty Nine-foot," multiple-bedded, impure, 2′ to	7	150
Shale, sandy, horizon of upper bench of **Clarksburg Red Shale**	24	174
Sandstone, Lower Connellsville (Hoffman of Maryland Survey?), massive, brown, 50′ to	25	199
Coal, Normantown, (Upper Hoffman of Maryland Survey?), 0′ to	1	200
Shale, sandy, horizon of middle bench of **Clarksburg Red Shale**	24	224
Coal, Lower Hoffman, lenticular, 0′ to	1	225
Shale, sandy	9	234
Coal, Upper Clarysville, lenticular, 0′ to	1	235
Shale, sandy	14	249
Coal, Lower Clarysville, lenticular, 0′ to	1	250
Shale, variegated and sandy, contains streak of limestone near Blaine, lower bench of **Clarksburg Red Shale**	40	290

	Thickness. Feet.	Total. Feet.
Sandstone, Morgantown, massive, gray, medium-hard, 30′ to	20	310
Shale, dark, sandy, 0′ to	4	314
Coal, Wellersburg "Rider," lenticular, 0′ to	1	315
Shale	9	324
Coal, Wellersburg, lenticular, 0′ to	1	325
Shale	4	329
Coal, Barton "Rider," lenticular, 0′ to	1	330
Sandstone, Barton, shaly, 30′ to	10	340
Shale, dark, 3′ to	6	346
Coal, Elk Lick, "Barton," "Four-foot," medium-hard, often double-bedded, and frequently bony at top and bottom, 2′ to	4	350
Shale, Birmingham, upper bench, variegated	39	389
Sandstone, Upper Grafton, massive, brown, medium-hard, 30′ to	10	399
Coal, Federal Hill, lenticular, 0′ to	1	400
Shale, Birmingham, middle bench, variegated	9	409
Coal, Duquesne, lenticular, 0′ to	1	410
Shale, Birmingham, lower bench, variegated	10	420
Sandstone, Grafton, massive, brown, hard	20	440
Shale, Ames, dark-green, with marine fossils (lenticular, fossiliferous limestones known as Upper and Lower Ames frequently occur near top and bottom of shale), 20′ to	8	448
Coal, Harlem, soft, single-bedded, 1′ to	2	450
Shale, Pittsburgh, upper bench, red and variegated	20	470
Sandstone, Jane Lew, massive or shaly, 10′ to	15	485
Shale, Pittsburgh, lower bench, red and variegated	20	505
Sandstone, Saltsburg, massive, gray or brown, sometimes pebbly, 20′ to	40	545
Shale, dark, 5′ to	0	545
Coal, Upper Bakerstown, soft, multiple-bedded, with several streaks of bony coal or shale, 1′ to	5	550
Shale, dark, sandy and ferruginous, 10′ to	25	575
Sandstone, Thomas, shaly or massive, 10′ to	20	595
Shale, dark, sandy, 5′ to	0	595
Coal, Bakerstown, "Thomas," soft, multiple-bedded, with several streaks of bony coal or shale, 3′ to	5	600
Shale, sandy	5	605
Limestone, Albright, fresh- or brackish-water origin, lenticular, 0′ to	1	606
Shale, sandy or slightly red	12	618
Limestone, Pine Creek, represented by a sandy, ferruginous zone in Piedmont region where it carries numerous marine fossils, lenticular, 0′ to	2	620
Shale, Meyersdale, sandy or red and variegated	10	630
Sandstone, Buffalo, gray, massive, medium-hard and medium-coarse	35	665
Shale and Limestone, Brush Creek, black, with marine fossils, 5′ to	9	674
Coal, Brush Creek, lenticular, 0′ to	1	675
Fire clay shale, Brush Creek	23	698
Sandstone, Upper Mahoning, massive, gray, hard, coarse, 10′ to	40	738
Limestone, Sutton, fresh- or brackish-water origin, len-		

	Thickness. Feet.	Total. Feet.
ticular, 0′ to	1	739
Shale, Mahoning, red, lenticular, 0′ to	5	744
Shale, dark, 0′ to	5	749
Coal, Mahoning, "Six-foot," soft, multiple-bedded, with streaks of bone or slate, minable in parts of Mineral but apparently worthless in Grant, 1′ to	6	755
Fire clay, Thornton, usually impure, 5′ to	10	765
Sandstone, Lower Mahoning, massive, gray, hard, coarse	25	790
Shale, **Uffington,** dark, sandy, 5′ to	10	800
Coal, Upper Freeport, "Split-six," "Davis," top member of Allegheny Series	....	.....

As detailed in the Tucker County Report mentioned above, the present section differs materially from previous long-standing interpretations of the Conemaugh Series of the Potomac region. It was formerly believed, with much show of reason, that the coal coming approximately 600 feet below the Pittsburgh represented the Upper Freeport of western Pennsylvania and that the coal at 350 feet below the same datum was the Bakerstown, the early assumption being based on a similarity of intervals and on a supposed identity of bed sections. That this could not be true, however, has been recently proved in an excellent paper by Drs. Swartz, Price, and Bassler[1] prepared as a result of investigations made for the Maryland Geological Survey, in which the gradual expansion of the Conemaugh Series eastward from Ohio, both through Pennsylvania and West Virginia, to the North Potomac region has been portrayed. With many conclusions and deductions of this paper the writer is in perfect agreement, but in a few important particulars must differ. In the upper portion of the series in Pennsylvania the paper indicates the presence of the Little Clarksburg Coal at approximately 100 feet below the Pittsburgh bed at Pittsburgh, and at about 160 feet below the same datum at Latrobe, Pennsylvania, where eastward thickening has occurred, while in West Virginia it is recognized at Morgantown at 140 feet below the Pittsburgh and in Preston County at 165 feet, the latter interval, however, being about 15 feet in excess of the general section of the Conemaugh published in the Preston County Report of the West Virginia Survey. In the Castleman, Somerset, Georges Creek, and Upper Potomac regions, lying south and southeast of Latrobe and northeast of Preston County, Dr. Swartz and his associates postulate the entire disappearance of this coal, but in the Castleman and

[1] C. K. Swartz, W. A. Price, and Harvey Bassler, Bull. Geol. Soc. Am., Vol. 30, pp. 567-596; 1919.

Georges Creek Basins, and on the Upper Potomac, indicate the appearance of the Franklin Coal at 110, 135, and 120 feet, respectively, below the Pittsburgh, this new coal (Franklin) being without apparent equivalent in their more western sections. The writer believes, inasmuch as the two supposed coals are at no point recorded in the same section and from the fact that the Franklin (Dirty Nine-foot) Coal of Maryland occurs at much the same interval below the Pittsburgh as the Little Clarksburg of West Virginia and furthermore has the same characteristic multiple bedding which the latter carries through many miles of its outcrop, that these seams assumed to be separate are one and the same, and has indicated such a relationship in the general section of the Conemaugh.[2]

In the lower portion of the series the position of the marine Pine Creek (Cambridge) Limestone is indicated by Dr. Swartz and his assistants as being between the two Bakerstown Coals (known in former literature of the region as Upper and Lower Freeport, respectively), the statement being made that this horizon loses its marine character in the eastern sections and is represented only by brackish-water fauna. The writer, on the contrary, finds that the typical sandy Pine Creek Limestone is present at Piedmont, carrying an abundant marine fauna, its position being between the (Lower) Bakerstown Coal and the Buffalo Sandstone, as

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[2] After the entire manuscript on the Stratigraphy of the Monongahela, Conemaugh, and Allegheny Series, (Chapters VI, VII, and VIII), had been prepared for this Report and after the measured sections of Chapter V were already in print, an excerpt of Vol. XI, Part I, of the Maryland Geological Survey, entitled "Second Report on the Coals of Maryland," was received through the courtesy of Dr. E. B. Mathews, State Geologist. An examination of this manuscript reveals the fact that the Little Clarksburg Coal is entirely removed from the nomenclature of the Conemaugh Series, the coal which is herein described as the Little Clarksburg ("Franklin," Dirty Nine-foot") being therein classified as the Franklin ("Dirty Nine-Foot"). From this important revision it would appear that the earlier view of Dr. Swartz and his associates that the Little Clarksburg Coal belongs far below the Franklin, as published in the Bulletin of the Geological Society of America previously mentioned, has been abandoned. In the same volume of the Maryland Survey several other changes of a much more subordinate nature have been made from the usage employed in the Bulletin mentioned. Inasmuch as the sections of Chapter V in this Report can not now be revised and later Chapters would be inharmonious if changed, all discussion and comparison with the work of the Maryland Survey or its members will be understood to have been based on the Bulletin of the Geological Society of America rather than on the later publication of the Maryland Survey prepared by the same author.

recorded in the Piedmont Section, page 156, and its position is accordingly so indicated in the general section. Neither marine nor non-marine fossils were observed at any point between the two Bakerstown Coals, although a persistent search was made at several good exposures, but the position is not taken that brackish-water forms are entirely absent, as they might have been overlooked. In the face of the apparently positive identification of the true Pine Creek at Piedmont it seems rational to infer that any non-marine fauna of that region coming between the two coals must represent a horizon distinct and separate from the Pine Creek (Cambridge). If further reinforcement of this view be needed it is found in the fact that the Upper Bakerstown Coal gradually thins out and disappears in passing from Piedmont southwestward to the head of the Potomac, until, at Thomas, Tucker County, only one coal is found, which quite evidently is the same as the Bakerstown of Preston and other more western counties of West Virginia where the marine Pine Creek Limestone is recognized, not above, but below this coal.

Farther down in the section the writer believes that the introduction of the name "Piedmont" for the coal coming about 75 feet below the marine Brush Creek Shale (with its underlying Brush Creek Coal) and about 45 feet above the Upper Freeport ("Split-six," "Davis") Coal is not warranted by present evidence in the Potomac Valley but that this coal much more probably represents the Mahoning bed, as only one coal appears to occur in this interval and the same has always been termed the Mahoning in more western regions.

With the above statements in view, minor corrections in the section of Dr. Swartz have been made to bring the subordinate, lenticular coals in harmony with the beliefs expressed, but at the same time it is freely admitted that several of these little coals are so rarely found and are so poorly tied by paleontologic or stratigraphic evidence that their proper correlation is subject to much doubt. There is abundant evidence, however, for the belief that the coal coming about 350 feet below the Pittsburgh at Piedmont, and formerly known as "Bakerstown," "Barton," "Four-foot," is identical with the Elk Lick of western Pennsylvania and northern West Virginia, the essential facts in support of this conclusion having been indicated by Dr. Swartz and perhaps more fully elaborated in the measured sections of Chapter V in this Report.

TOPOGRAPHIC EXPRESSION, CONEMAUGH SERIES.

In its present stage of erosion the Conemaugh Series in Mineral and Grant Counties is represented by a somewhat rugged topography in which steep slopes are the rule, variation being afforded by the heavier and more durable sandstone members which make slight shoulders standing out beyond the general profile, but which seldom stand out in bold or overhanging ledges. The usual absence of such cliffs is probably due to the heavy accumulation of debris which has littered many of the slopes with a heavy covering of natural riprap, holding the soft intervening shales in place and preserving them from the rapid disintegration that might otherwise have occurred. In localities where less protection is afforded by boulders, landslides are common in the red shales, adding perceptibly to the general roughness of the slopes. Above the general valley walls of North Branch of the Potomac and its major tributaries there are extensive uplands which are remnants of the old Schooley Peneplain and belong at no particular stratigraphic level, as previous folding had already occurred to alter the original horizontal beds. These uplands are well adapted to grazing and agriculture and form a pleasing contrast to the rough, wooded slopes of the valleys.

AREAL EXTENT, CONEMAUGH SERIES.

The Conemaugh Series of the two counties is wholly confined to the valley and tributaries of North Branch of Potomac River where it outcrops in an extensive area having the shape of a rude isosceles triangle, the slightly truncated apex of which is at Piedmont with a width of about two miles, and the base of which extends from Fairfax Knob at the headwaters of the river southeastward to the Stony River Dam and slightly beyond with a width of about twelve miles. The northwestern side of the triangle, approximately parallel to the general alignment of North Branch, extends from Piedmont to Fairfax Knob, a distance of about 30 miles and the southeastern side, parallel to and approximately one-half mile northwest of the escarpment of the Allegheny Front, reaches from Piedmont to a point near the Bear Rocks southeast of Stony River Dam. The outcrop embraces the main territory along the North Potomac (Georges Creek) and Stony River Synclines, and a considerable portion of the intervening Blackwater Anticline, which is of comparatively low

Photo by E. E. HARRIS.

PLATE X.—View from low point 0.7 mile north of Alaska, looking southeast across valley of Patterson Creek, with village of Alaska (Frankfort) partly visible. Topography in foreground is Hamilton followed by Genesee and Portage, with Chemung visible in the synclinal summit of Middle Ridge in right background.

structural relief, there being small, isolated areas along the axes of the two basins where the series is covered by Monongahela beds and narrow belts along the major streams where older rocks are exposed.

CONTACTS, CONEMAUGH SERIES.

The upper contact of the Conemaugh Series, with the Monongahela, has already been discussed in the description of the latter rocks, page 198. Its lower contact, with the Allegheny Series of the Pennsylvanian, has been arbitrarily placed at the top of the Upper Freeport Coal, based on the economic view that this level represented a change from sediments that were largely barren of coals to rocks that were rich in these deposits. As previously stated, such a distinction is hardly applicable to the Potomac Valley where several important coals are found in the Conemaugh, although the old usage is still a convenient one and is herein followed. From a strictly scientific standpoint, however, there is no unconformity at the top of the Upper Freeport Coal while, on the other hand, the first presence of red beds is noted about 50 feet above it and just over the Mahoning Coal. Inasmuch as these red beds are typical of the Conemaugh the latter level would appear to be a more logical division plane.

FOSSIL LIFE, CONEMAUGH SERIES.

In the Conemaugh Series of the two counties marine, invertebrate remains were observed and collected from three fossil zones, of which the Ames Shale belongs 440 to 450 feet below the top of the series, the Pine Creek Limestone about 620 feet below the top, and the Brush Creek Shale and Limestone about 675 feet below the top or about 125 feet above the base. The stratigraphic associations of these three horizons are indicated in the general section of the Conemaugh, page 204, and their descriptions will be found in the present Chapter, but fossil lists and other paleontologic notes are given in Chapter XXI. All of these fossil beds are thin and recognizable only after patient search, being often totally obscured by debris.

In other counties of the State, as well as elsewhere in the Appalachian Basin, fresh- or brackish-water remains have been found in other zones of the series, some of which have been doubtfully described as of marine origin. At one locality, also, in Braxton County, West Virginia, a large Pareiasaurus-like bone of a vertebrate reptile has been found,

a description of which by Prof. E. C. Case, is given in the Braxton and Clay Report of the Survey, and on which further comment by Dr. R. S. Lull will be found in Chapter XXI of the present Report. The Conemaugh shales are very rich in plant remains, but of these no study has been made for the present Report.

DESCRIPTION OF MEMBERS, CONEMAUGH SERIES.

FAIRFAX LIMESTONE.

The **Fairfax Limestone,** coming a few feet under the Pittsburgh Coal, was observed only at Fairfax Knob, Grant County, at the extreme head of North Branch of Potomac River, where, as shown by the Fairfax Section, page 190, it is two feet thick. At this locality it is a gray, pure bed, weathering to yellow, and evidently of fresh-water origin.

MORANTOWN COAL.

The **Morantown Coal,** coming about 20 feet below the Pittsburgh Coal and apparently having no counterpart in that portion of the State west of the Potomac Valley, is a thin, impure, and lenticular bed of no apparent commercial value. In Mineral County it was once opened at the **Silver Coal Company Prospect (No. 36 on Map II),** on Montgomery Run of North Branch, 0.8 mile south of Hampshire, at an elevation of 2018′ B., as indicated in the section for Piedmont, page 155. No report as to its thickness or character at this point was obtained. In the same county it was observed in the public road 0.3 mile west of Elk Garden at **Exposure No. 37 on Map II,** having a thickness of 0′ 6″ and an elevation of 2300′ B., as shown in the Elk Garden Section, page 168. In Grant County it was once opened at the **Davis Coal & Coke Company Prospect (No. 38 on Map IV)** near the top of Fairfax Knob on the headwaters of North Branch, at an elevation of 3182′ L., as indicated in the Fairfax Section, page 190. This place, also, has fallen shut but according to S. B. Jeffries, Chief Engineer of the company, it had a thickness of 4′ 4″, no details being available as to its parting slates or chemical character.

LOWER PITTSBURGH SANDSTONE.

The **Lower Pittsburgh Sandstone,** coming 60 to 70 feet below the Pittsburgh Coal, is a shaly stratum of small interest, being usually not more than 5 to 10 feet in thickness, as compared to a much more prominent ledge in counties farther west. Its stratigraphic position is indicated in the

Elk Garden Section, page 168, where it is only 5 feet thick and shaly, and in the Fairfax Section, page 190. Owing to its character it has no apparent value as a building stone.

LITTLE PITTSBURGH COAL.

The **Little Pittsburgh Coal,** coming 70 to 80 feet below the Pittsburgh Coal and a few feet under the Lower Pittsburgh Sandstone, is a lenticular, multiple-bedded deposit of small apparent value but it has been mined commercially in Fairfax Knob and its further description, together with sections and estimates of tonnage, will therefore be found under the subject of "Commercial Coal" in Chapter XVII.

SECOND LITTLE PITTSBURGH COAL.

The **Second Little Pittsburgh Coal,** coming 105 to 110 feet below the Pittsburgh and about 30 feet below the Little Pittsburgh Coal, is a lenticular bed of infrequent occurrence and no apparent economic value. It is observed only in Mineral County at **Exposure No. 42 on Map II,** in the public road 0.5 mile west of Elk Garden, where its slaty blossom occurs at an elevation of 2245′ B., as indicated in the Elk Garden Section, page 168.

CONNELLSVILLE SANDSTONE.

The **Connellsville Sandstone,** belonging a few feet under the Second Little Pittsburgh Coal, and having its base 120 to 140 feet below the Pittsburgh Coal, is a grayish or brown, massive ledge, apparently varying from 10 to 30 feet in thickness. It makes no prominent outcrops, being usually obscured by drift but in the section for Howell Run, Mineral County, as published on page 165, it is noted as 20 feet thick and massive. So far as known it has not been quarried in either county but in the Monongahela Valley it has often been used for building stone with satisfactory results and it could probably be utilized for this purpose in Mineral and Grant if so desired.

FRANKLIN "RIDER" COAL.

The **Franklin "Rider" Coal** belonging just under the Connellsville Sandstone and a few feet above the Little Clarksburg (Franklin) Coal, and having an approximate interval of 130 feet below the Pittsburgh, is a thin and lenticular bed of no apparent value. It was noted only in Mineral County as **Exposure No. 43 on Map II** in the public road 0.6 mile west of Elk Garden at an elevation of 2235′ B., where

its blossom is one foot thick, as recorded in the Elk Garden Section, page 168.

LITTLE CLARKSBURG ("FRANKLIN," "DIRTY NINE-FOOT") COAL.

The **Little Clarksburg Coal,** coming 140 to 160 feet below the Pittsburgh Coal, and known in the Potomac Valley as the **"Franklin,"** or **"Dirty Nine-foot,"** is a multiple-bedded, impure deposit, having a thickness that varies from 2 to 7 feet, of which there are several benches of good, soft coal, separated by shales, the section being quite variable and usually exposed only in part. This bed has not been mined commercially in either county but it has been prospected at several points and has been used for domestic fuel with good results so that it would appear to have a definite value as a fuel reserve of the future. As such its extent, chemical character, and detailed sections, together with estimates of tonnage, will be further discussed in Chapter XVII under the subject of "Commercial Coal." Its outcrop is indicated on Maps II and IV.

As previously mentioned on pages 205-6, members of the Maryland Survey have held that the Little Clarksburg Coal of West Virginia and the Franklin of the Potomac Valley are separate seams, but as further discussed in the same reference the writer believes that there is little or no tangible evidence in support of such a view, while, on the other hand, there is much ground for considering them an identical and continuous bed, and they are therefore so treated in this Report.

CLARKSBURG RED SHALE.

The **Clarksburg Red Shale,** which, at its type locality in Harrison County, West Virginia, comes below the Clarksburg Limestone (a stratum which in that region lies a few feet under the Little Clarksburg Coal) and just above the Morgantown Sandstone, but which in other regions of the Monongahela Valley is divided into two benches by the Lower Connellsville Sandstone and its underlying Normantown Coal, appears to be even further subdivided in Mineral and Grant Counties by additional coals and sandy shales. The Clarksburg Limestone was not observed in this region but between the Little Clarksburg Coal and the Morgantown Sandstone there is an approximate interval of 140 feet, as compared to 60 to 75 feet in the Monongahela Valley, and in this interval there is the well-defined Lower Connellsville Sandstone, as well as three coals and apparently three beds

of red or variegated shale. It seems apparent that eastward expansion has greatly enlarged and altered the Clarksburg Red Shale stage so that there are three distinct benches, one of which lies between the two Connellsville Sandstones, another between the Normantown and Lower Hoffman Coals, and a third between the Lower Clarysville Coal and the Morgantown Sandstone, as indicated by the General Section of the Conemaugh, page 203. These red beds appear at various points in the two counties, their presence being shown in several measured sections in Chapter V. They are of value as makers of good agricultural soil and at convenient points might be utilized for building brick if so desired.

LOWER CONNELLSVILLE SANDSTONE.

The **Lower Connellsville Sandstone,** belonging within the body of the Clarksburg Red Shale and having its base 50 to 60 feet below the Little Clarksburg Coal, is a grayish or brown, massive ledge, apparently varying in thickness from 25 to 50 feet, being usually hard and durable, although shaly in some localities. In Chapter V its presence is recorded in the sections for Luke (20′ thick), Howell Run (25′ thick), Shaw (100′ thick), and Hampshire (45′ thick). At Shaw, where an excessive thickness is noted, it is partly concealed but seemingly represents a single bed which is locally much greater than usual. As a rule this sandstone seldom stands out in bold cliffs, being usually largely covered by soil. So far as known it has not been quarried but in some localities it would furnish durable building stone.

It appears probable that the Lower Connellsville Sandstone correlates with the **Hoffman Sandstone** listed by members of the Maryland Survey, although definite proof of this view is lacking.

NORMANTOWN COAL.

The **Normantown Coal,** coming just under the Lower Connellsville Sandstone, and 50 to 60 feet below the Little Clarksburg Coal, is a thin and lenticular bed of no apparent economic value, being little more than a marker at most points. In Mineral County its blossom was observed at **Exposure No. 59 on Map II** on the west side of Piney Swamp Run, 1 mile southwest of Hampshire, at an elevation of 1615′ B., as shown in the Shaw Section. In the same county it is again visible at **Exposure No. 60 on Map II** on a branch of Howell Run, 0.7 mile southeast of Shaw, at an elevation of 1815′ B., as recorded in the Howell Run Section, and on the

hill road 0.4 mile south of Shaw its blossom was noted at an elevation of 1800′ B. In the same county the blossom occurs again at **Exposure No. 61 on Map II** on a branch of Deep Run, 0.6 mile east of Elk Garden, at an elevation of 2030′ B. In Grant County it was once opened at the **Davis Coal & Coke Company Prospect (No. 62 on Map IV)** on the east slope of Fairfax Knob near the head of the Potomac, at an elevation of 3054′ B. This prospect had fallen shut, but, so far as learned, little coal was found.

It would appear that this coal is the same as that which has been classified as the **Upper Hoffman** by members of the Maryland Survey, although positive evidence in support of such a correlation is lacking.

LOWER HOFFMAN COAL.

At an interval of 20 to 25 feet below the Normantown Coal and at 60 to 70 feet below the Little Clarksburg Coal there is a thin and lenticular seam of coal that has no stratigraphic equivalent in the Conemaugh section of more western counties of the State, and it would appear to be the same as the **Lower Hoffman Coal** listed by members of the Maryland Survey, although satisfactory proof is lacking. This coal is little more than a blossom and was noted only in Mineral County at **Exposure No. 63 on Map II** on the north side of Howell Run, 0.5 mile southeast of Shaw, at an elevation of 1735′ B., where its blossom is visible as recorded in the Howell Run Section, page 165.

UPPER CLARYSVILLE COAL.

At an interval of 10 to 15 feet below the coal described as the Lower Hoffman and 80 to 90 feet below the Little Clarksburg there is another lenticular bed of infrequent outcrop and no apparent economic value that has no corresponding place in the Conemaugh column of the Monongahela Valley. This coal would appear to be the same as the **Upper Clarysville Coal** listed by members of the Maryland Survey, although such an interpretation is hardly capable of proof owing to the lack of evidence. It was observed only in Grant County at **Exposure No. 64 on Map IV** along the ridge road 1.3 miles southeast of Mount Storm, at an elevation of 2920′ B., where its blossom is visible.

LOWER CLARYSVILLE COAL.

At 15 to 20 feet below the coal described as the Upper Clarysville there is another thin streak that is likewise lack-

ing in the Conemaugh section of more western counties. This coal belongs about 100 feet below the Little Clarksburg and at about the same interval above the Elk Lick and by inference would appear to be the same as the **Lower Clarysville Coal** listed by members of the Maryland Survey. It is thin and lenticular, having been noted only in Grant County at **Exposure No. 65 on Map IV** along the ridge road 1.2 miles southeast of Mount Storm, at an elevation of 2890′ B.

MORGANTOWN SANDSTONE.

The **Morgantown Sandstone,** coming 300 to 325 feet below the Pittsburgh Coal and 40 to 50 feet above the Elk Lick Coal, is a well-marked and readily identified member of the Conemaugh of the two counties. As a rule it is massive, gray and medium-hard, with a thickness of 20 to 40 feet. In the Piedmont Section it is recorded as a massive cliff, 33 feet thick, and in the Bloomington Section as 20 feet thick and massive. In the Shaw Section it is noted as 35 feet thick and massive, and along the road between Blaine and Elk Garden it is 20 feet thick and massive. Along the Elk Garden Branch of the Western Maryland Railway east of Abram Creek and 0.9 mile east of Oakmont there is 20 feet of it exposed in a cut at an elevation of 2155′ B., being massive and having veins of travertine which have filtered into it from the limy Clarksburg Shale above it. So far as known it has not been quarried in the two counties. In the Monongahela Valley, where it has been used extensively, it has proved to be easily quarried and dressed but has a tendency toward rapid weathering owing to the evident amount of included feldspar. For this reason it can scarcely be recommended for ornamental stone but it would serve for rough masonry if desired.

WELLERSBURG "RIDER" COAL.

The **Wellersburg "Rider" Coal,** listed by members of the Maryland Survey as coming a few feet under the Morgantown Sandstone, and being without stratigraphic equivalent in the Conemaugh of the Monongahela Valley, seems to be represented only by a lenticular blossom in the two counties, the only point where it was observed being at **Exposure No. 66 on Map II** on the hill road 0.7 mile southwest of Shaw, Mineral County, at an elevation of 1765′ B., as recorded in the Shaw Section.

WELLERSBURG COAL.

The **Wellersburg Coal,** coming a few feet under the Wellersburg "Rider" Coal and 15 to 20 feet below the Morgantown Sandstone, is another bed that has no equivalent in the western sections but is listed by members of the Maryland Survey as occurring in the Georges Creek and Castleman Basins in that State as well as in the Somerset region of Pennsylvania. In the North Potomac region this coal appears to be thin, lenticular, and without economic interest, its blossom having been observed only at **Exposure No. 67 on Map II** along the hill road 0.7 mile southwest of Shaw, Mineral County, at an elevation of 1750′ B.

BARTON "RIDER" COAL.

The **Barton "Rider" Coal,** coming 20 to 30 feet below the Morgantown Sandstone and 20 to 25 feet above the Elk Lick ("Barton") Coal, is another bed that occurs only in the eastern phase of the Conemaugh, being confined to the North Potomac (Georges Creek) Basin according to members of the Maryland Survey. In the territory of this report it appears to be entirely too thin and lenticular to have economic value but its blossom was noted at several points and there is no doubt as to its presence. In Mineral County its blossom was observed at **Exposure No. 68 on Map II** on the north side of Howell Run, 0.4 mile southeast of Shaw, at an elevation of 1685′ B., as indicated in the Howell Run Section, and on the hill road 0.6 mile southwest of Shaw the blossom is present again at **Exposure No. 69 on Map II,** at an elevation of 1715′ B. In the same county the blossom is again visible at **Exposure No. 70 on Map II** on a branch of Deep Run, 0.6 mile east of Elk Garden, at an elevation of 1925′ B In Grant County an attempt was recently made to mine it at **Prospect No. 71 on Map IV** on the west side of Johnny-cake Run of Abram Creek, 2.2 miles northeast of Mount Storm, at an elevation of 2455′ B. This prospect had fallen shut but according to local report little coal was found.

BARTON SANDSTONE.

The **Barton Sandstone** of the Maryland Survey, coming just below the Barton "Rider" Coal and a few feet above the Elk Lick Coal, is another stratum confined to the eastern Conemaugh. In Mineral County it is well exposed on the eastern side of Montgomery Run of North Branch, 0.8 mile southwest of West Virginia Central Junction, being 28

feet thick and shaly, as recorded in the Piedmont Section, page 156. It is without economic interest as it would not make durable building stone.

ELK LICK ("BARTON," "FOUR-FOOT") COAL.

The **Elk Lick ("Barton," "Four-foot") Coal**, coming 340 to 360 feet below the Pittsburgh Coal and a few feet under the Barton Sandstone, is one of the most regular and consistent members of the entire Conemaugh. In the Potomac Valley it has long been mined commercially as "Bakerstown Coal" under the mistaken assumption that it correlated with the seam of that name in western Pennsylvania. That this can not be true, however, is clearly indicated in the discussion that follows the General Section of the Conemaugh Series near the beginning of this Chapter, where it is shown that the true Bakerstown Coal belongs approximately 250 feet below the "Barton," or "Four-foot" bed.

The Elk Lick Coal, as correlated in this Volume, is a medium-hard and often double-bedded deposit, frequently carrying streaks of bone at top and bottom, and is a valuable commercial bed. Its outcrop is shown on Maps II and IV and its extent, chemical character, and tonnage, together with numerous measured bed sections, will be further discussed in Chapter XVII under the subject of "Commercial Coal."

BIRMINGHAM SHALE.

The **Birmingham Shale**, embracing a heterogeneous mass of red, variegated and sandy beds between the Elk Lick Coal and Grafton Sandstone in the Monongahela Valley, appears to be expanded in the Potomac region by the occurrence of a well-defined sandstone (Upper Grafton) and by two streaks of coal (Federal Hill and Duquesne), so that three distinct benches of the shale occur, as indicated in the General Section of the Conemaugh, page 204, the total interval from the Elk Lick Coal to the top of the Grafton Sandstone being 70 to 80 feet. The presence of this shale is indicated in various sections in Chapter V, as well as in coal test borings in Chapter XVII. Its chief economic value is that of a soil maker but portions of it might doubtless be used for making building brick if desired.

UPPER GRAFTON SANDSTONE.

The **Upper Grafton Sandstone** of the Maryland Survey, having its base about 50 feet below the Elk Lick Coal, from which it is separated by the upper bench of the Birmingham Shale, is a persistent ledge, being usually brown, massive,

and coarse, but sometimes shaly, and having a thickness of 10 to 30 feet. In Chapter V it is noted in the Luke Section as 22 feet thick, massive and brown, in the Bloomington Section as 18 feet thick and shaly, in the Savage River Section as 20 feet thick, in the Howell Run Section as 40 feet thick and shaly at the top, and in the Shaw Section as 9 feet thick and massive. Its presence is also recorded in several coal test borings in Chapter XVII. So far as known this ledge has not been quarried in either county but in localities where it is massive and cemented by brown peroxide of iron it should make durable building stone of a pleasing texture.

FEDERAL HILL COAL

The **Federal Hill Coal** of the Maryland Survey, coming a few feet under the Upper Grafton Sandstone and about 50 feet below the Elk Lick Coal, is a fairly persistent bed, although usually less than one foot in thickness, and having no economic importance. Owing to the presence of a green fissile shale above it at some localities that much resembles the Ames in appearance, the Federal Hill Coal may easily be mistaken for the Harlem but it can be distinguished from the fact that the shale above it apparently carries no marine fossils and by its interval from the Elk Lick Coal which is only about 50 feet as compared to 100 feet for the Harlem.

In Mineral County the Federal Hill Coal was observed at **Exposure No. 132 on Map II** in the public road east of Montgomery Run, 1.3 miles southeast of Piedmont, at an elevation of 1646′ B., where its blossom occurs; also at the following exposure where its relationship to the Upper Grafton Sandstone is indicated:

Kalbaugh Coal Company Exposure—No. 133 on Map II.

In road on east side of North Branch of Potomac River, 0.4 mile southeast of Barnum; **Federal Hill Coal**; elevation, 1570′ B.

	Ft.	In.
Shale, green	10	0
Sandstone, **Upper Grafton**	15	0
Shale, sandy	5	0
Coal	1	0
Shale, yellow		

In the same county its blossom is visible at **Exposure No. 134 on Map II** on the north side of Howell Run, 0.3 mile southeast of Shaw, at an elevation of 1590′ B., as reported in the Howell Run Section; also at **Exposure No. 135 on Map II** along the hill road 0.4 mile southwest of Shaw, at an elevation of 1655′ B., as indicated in the Shaw Section; also

at **Exposure No. 136 on Map II** on the west side of Deep Run, 0.7 mile east of Elk Garden, at an elevation of 1865′ B.; also at **Exposure No. 137 on Map II** along the hill road 0.5 mile southeast of Blaine, at an elevation of 2045′ B.; also at the **Mapleville Coal Company Prospect (No. 138 on Map II)** on the east side of Abram Creek, 0.8 mile east of Oakmont, at an elevation of 2065′ B., where only a small amount of coal was found; also at **Exposure No. 139 on Map II** on the west side of Abram Creek, 0.8 mile southwest of Emoryville Station, at an elevation of 2175′ B.; and also at the following prospect:

Low Volatile Coal Company Prospect—No. 140 on Map II.

On west side of Emory Run, 0.8 mile southeast of Emoryville Station; **Federal Hill Coal**; elevation, 2060′ B.

	Ft.	In.
Sandstone, shaly, **Upper Grafton**		
Shale, sandy	4	0
Slate, black, cannelly at base	4	0
Coal, bony	0	7
Pavement (?), concealed by water		

In Grant County the blossom of the coal was noted at **Exposure No. 141 on Map IV** on the west side of Abram Creek, 2.1 miles southwest of Wabash, at an elevation of 2380′ B., and also at **Exposure No. 142 on Map IV** on the east side of Abram Creek, 1.6 miles northeast of Bismarck, at an elevation of 2900′ B.

It is barely possible that the Federal Hill Coal may be the same seam as the West Milford Coal of Harrison County, West Virginia, but the presence of Birmingham Shale above it is a point against such an interpretation.

DUQUESNE COAL.

The **Duquesne Coal** of the Maryland Survey, occurring within the expanded body of the Birmingham Shale and having no equivalent in the Monongahela Valley, is a thin and lenticular bed of no economic importance and small scientific interest. It belongs about 10 feet below the Federal Hill Coal and was noted only at **Exposure No. 143 on Map II** on the hill road 0.4 mile southwest of Shaw, Mineral County, where its blossom is exposed at an elevation of 1645′ B.

GRAFTON SANDSTONE.

The **Grafton Sandstone,** coming just below the lower bench of the Birmingham Shale and just above the fossiliferous Ames Shale, is a massive, hard, brown, coarse stratum,

often mottled with inclusions of iron peroxide, varying in thickness from 10 to 30 feet and being usually quite constant in its occurrence. In Chapter V it is recorded in the Luke Section as 8 feet thick, massive and gray, in the Bloomington Section as 2 feet thick, in the Barnum Section as 28 feet thick and massive, in the Howell Run Section as 20 feet thick, and in the Bayard Section as 25 feet thick and massive. In Chapter XVII it is also indicated in various coal test borings. So far as known it has not been quarried in the two counties, but judging from its texture and durable quality it would make good building stone.

AMES SHALE AND LIMESTONE.

The **Ames Shale and Limestone,** coming just under the Grafton Sandstone and approximately 450 feet below the Pittsburgh Coal and being about 350 feet above the Upper Freeport Coal, is one of the most persistent and wide-spread members of the entire Conemaugh. It has been recognized and traced throughout northern and central West Virginia, eastern Ohio, western Pennsylvania, and western Maryland. In the Potomac Valley of Mineral and Grant Counties its outcrop is often covered with a thick mantle of debris which doubtless accounts for the fact that it has been recognized in that region only within the past few years after an intensive study of the rocks was begun, and the failure of early geologists to find it there, along with other fossiliferous members of the Conemaugh, accounts in large measure for the unfortunate mistakes in correlation that have occurred in the valley.

The Ames Shale, as a rule, is olive-green in color, fissile, 5 to 25 feet in thickness, and carries marine invertebrate fauna, **Chonetes granulifer** being typical and **Ambocoelia planoconvexa** and **Derbya crassa** being recorded as abundant. In many regions it often contains lenses of dark, impure, carbonaceous limestone that are highly fossiliferous and for that reason is frequently called the **Ames Limestone** in reports, but in the Potomac Valley these lenses are of infrequent occurrence and its description solely as a limestone would therefore be misleading.

In Chapter V the Ames Shale is recorded in the sections for Luke, Piedmont, Hampshire, Barnum, Elk Garden, and Gleason, fossils being noted at several of these localities. Marine remains were noted on the north side of Piney Swamp Run, Mineral County, at Coal Prospect No. 145, one mile northeast of Tasker School, at an elevation of 2390′ B.; also

at several localities on Deep Run, Mineral County, one of which is on the east side, 0.3 mile northeast of Nethken, at an elevation of 1730′ B., there being limestone at this point; another on the west side, at Coal Prospect No. 148, 0.5 mile north of Nethken, at an elevation of 1670′ B.; another on the west side, 0.7 mile east of Elk Garden, at an elevation of 1795′ B.; and another on the west side, at Coal Prospect No. 150, 1.2 miles southeast of Elk Garden, at an elevation of 1900′ B. On Abram Creek, Mineral County, fossils were observed on the east side of the stream at Coal Prospect No. 152, 0.8 mile east of Oakmont, at an elevation of 2025′ B., and on the west side of the same stream, in Grant County, at Coal Prospect No. 154, 1.5 miles northeast of Bismarck, at an elevation of 2845′ B. In Grant County, also, they were seen at Coal Prospect No. 156 on the west side of Mill Run of Stony River, 1.2 miles northwest of Bismarck, at an elevation of 2820′ B.; also at Coal Exposure No. 159 on the west side of Difficult Creek, 1.7 miles southeast of Gormania, at an elevation of 2680′ B.; also at Coal Prospect No. 158 on the east side of Stony River, 0.5 mile east of the mouth of Helmick Run, at an elevation of 3350′ B. In Garrett County, Maryland, they were observed at Coal Exposure No. 161, on Glade Run, 1.5 miles northeast of Gorman, at an elevation of 2440′ B.; and also on the south side of the Potomac River just south of Kempton, at an elevation of 2720′ B.

In Chapter XXI will be found lists of fossils collected at several of the localities noted above, together with Dr. John L. Tilton's remarks on the same.

The following is a summary of all collections from the Ames stage in the two counties:

Composita subtilita Hall
Orthotetes (Derbya) crassus Meek and Hayden
Deltopecten (Limipecten) occidentalis Shumard
Aviculopecten sp. a Girty
Aviculopecten parvulus Hall and Whitfield
Productus cora d'Orbigny
Productus nebrascensis Owen
Dentalium (sp.?)
Edmondia aspinwallensis Meek
Euomphalus catilloides Conrad
Euphemus carbonarius Cox?
Ischilina (sp.?) Jones.

HARLEM COAL.

The **Harlem Coal**, coming just under the Ames Shale and about 450 feet below the Pittsburgh Coal, is a soft, single-bedded deposit, varying from 1 to 2 feet in thickness. In the major portion of the two counties it is too thin for mining but in restricted localities where it attains the maximum thickness, it seems quite likely that it will eventually be

mined, owing to its purity and freedom from slate. Its further discussion will therefore be reserved for Chapter XVII, where detailed sections, chemical analyses, and estimates of tonnage will be presented under the subject of "Commercial Coal."

PITTSBURGH RED SHALE.

The **Pittsburgh Red Shale,** coming just below the Harlem Coal and being separated into two benches by the Jane Lew Sandstone, is a red or variegated deposit, much slickensided and irregular in its bedding. Exclusive of the included sandstone the thickness of the two benches usually totals 50 to 75 feet. It is quite susceptible to the action of water owing to its lack of porosity and tendency to puddle and is responsible for many landslides, making a highly unstable foundation for buildings and roads. In Chapter V its presence is recorded in the sections for Piedmont and Elk Garden, and in Chapter XVII it is indicated in the records of various coal test borings. The principal economic value of this shale is as a soil maker but in the Monongahela Valley it has been used extensively for the manufacture of building brick and it could be so used in Mineral and Grant Counties if desired.

JANE LEW SANDSTONE.

The **Jane Lew Sandstone,** coming within the body of the Pittsburgh Red Shale and having its base 35 to 50 feet below the Harlem Coal, is usually a shaly but sometimes massive stratum, gray or brown in color, and varying in thickness from 10 to 15 feet. In the Schell Section, page 173 it is noted as 10 feet thick, and on Abram Creek, Grant County, it is visible at the mouth of Johnnycake Run where it is only partly above drainage. It is also recorded in various coal test borings in Chapter XVII. Its shaly nature would make it generally unfit for building stone.

SALTSBURG SANDSTONE.

The **Saltsburg Sandstone,** coming just below the lower bench of the Pittsburgh Red Shale and almost directly above the Upper Bakerstown Coal, is a massive, gray or brown stratum, frequently mottled with iron peroxide and sometimes pebbly, its thickness varying from 20 to 40 feet and its occurrence being quite regular and consistent. In Chapter V it is recorded in the Luke Section as 38 feet thick, massive and gray, in the Piedmont Section as 30 feet thick and massive, in the Bloomington Section as 35 feet thick and

massive, in the Hampshire Section as 38 feet thick and massive, in the Barnum Section as 22 feet thick and massive, in the Shaw Section as 35 feet thick and massive, in the Elk Garden Section as 15 feet thick and massive, and in the Hubbard Section as 40 feet thick, massive and pebbly. It is also noted in many coal test records and in sections of the Upper Bakerstown Coal in Chapter XVII. So far as known this sandstone has not been quarried in either county, but at Kingwood, Preston County, as well as at other points in the Monongahela Valley it has been used extensively for general building and ornamental stone with entirely satisfactory results, as it is both durable and of a very pleasing texture.

PORTERSVILLE LIMESTONE.

The **Portersville Limestone,** described by members of the Maryland Survey as lying just between the Saltsburg Sandstone and Upper Bakerstown Coal and as containing a meager fauna little known east of Ohio, was not identified as a fossiliferous zone in Mineral and Grant. Its horizon, occupied by 6½ feet of gray, sandy shale, is exposed northeast of Luke as shown in the Luke Section, page 158.

UPPER BAKERSTOWN COAL.

The **Upper Bakerstown Coal** of the Maryland Survey, coming a few feet below the Saltsburg Sandstone and approximately 550 feet below the Pittsburgh Coal, is another important bed that seems to occur only in the eastern phase of the Conemaugh, as it has no representative in the western sections. This coal is usually soft and multiple-bedded, with several streaks of bony coal or shale, its total thickness varying from 1 to 5 feet. It is best developed in Mineral County along the North Branch and its tributaries between Piedmont and Abram Creek but southwest of the latter locality it rapidly thins out until little or no coal is found at its horizon at the headwaters of the Potomac. Being of commercial thickness over a considerable territory its further discussion will be reserved for Chapter XVII where detailed sections, chemical analyses, and estimates of tonnage will be found under the subject of "Commercial Coal."

CAMBRIDGE LIMESTONE.

The **Cambridge Limestone,** described by members of the Maryland Survey as coming just over the "Thomas Sandstone," which in turn overlies the Bakerstown Coal, and as carrying marine fauna, could not be identified as a fossil-

iferous zone on either side of the Potomac by the writer, although a persistent search was made at this horizon in the vicinity of Piedmont and Luke where it is fully exposed.

THOMAS SANDSTONE.

The **Thomas Sandstone** of the Maryland Survey is described as occupying part of the interval between the Upper Bakerstown and (Lower) Bakerstown Coals and as deriving its name from its supposed relationship with the Bakerstown (Thomas) Coal at Thomas, Tucker County. With this view, however, the writer is not in accord, as the sandstone which overlies the Bakerstown Coal at Thomas seems quite clearly the same as that which may be observed at many points along North Branch of Potomac between Thomas and Piedmont and which at the latter locality lies over the Upper Bakerstown Coal and which is apparently the true Saltsburg Sandstone. Between Gorman and Piedmont a new sandstone occurs, lying between the two Bakerstown Coals and having no counterpart in the vicinity of Thomas, and being usually shaly and thin and little resembling the outcrop at Thomas. That being the case the title "Thomas Sandstone" appears to be a misnomer, but as its horizon does not occur elsewhere in West Virginia the name has been included in the General Section of the Conemaugh in this Volume, although a description under the title **"Lower Saltsburg"** would have been much preferred.

The Thomas Sandstone in the region where it occurs is usually shaly and 10 to 15 feet in thickness. In Chapter V it is noted in the sections for Shaw, Elk Garden, and Gleason, and in Chapter XVII it is recorded at several sections of the Bakerstown Coal, as well as in certain coal test borings. So far as known it has not been quarried and its shaly character would generally preclude its use as a building stone.

BAKERSTOWN ("THOMAS") COAL.

The **Bakerstown Coal,** coming a few feet under the "Thomas" Sandstone in Mineral County, but almost directly underlying the Saltsburg on the headwaters of the Potomac where the former rock and the Upper Bakerstown Coal have practically disappeared from the section, is a wide-spread and persistent member of the Conemaugh. As fully explained in remarks following the general section of the Conemaugh Series at the beginning of this Chapter, this coal has long been mistaken in the Potomac Valley for one

Photo by E. E. HARRIS.

PLATE XI.—View from road about one mile northeast of Reeses Mill, looking southwest across valley of Patterson Creek showing smooth foreground made by Genesee and Hamilton shales along Tussey Mountain Anticline, followed by low wooded hills of Portage rocks. Knobly Mountain, with slopes of Oriskany Sandstone, is faintly visible in background.

of the Freeport Coals of the Allegheny Series, but the error of this early view is now so apparent as to need no further discussion. This coal is soft and multiple-bedded with several streaks of bony coal or shale, its total thickness varying from 3 to 5 feet, and its presence being general in both Mineral and Grant Counties except over small, locally barren areas. It has been mined commercially along the valley for many years under the trade name of "Freeport Coal." Its further discussion will be found in Chapter XVII, together with sections, analyses, and estimates of tonnage, under the subject of "Commercial Coal," and on Maps II and IV, its outcrop is delineated.

ALBRIGHT LIMESTONE.

The **Albright Limestone,** belonging a few feet under the Bakerstown Coal at its type locality in Preston County, and being of fresh- or brackish-water origin, was not observed at outcrop in either of the two counties, but on the upper waters of North Branch a limestone is recorded in a few coal test borings that seems to represent its horizon.

PINE CREEK LIMESTONE.

The **Pine Creek Limestone,** coming 15 to 30 feet below the Bakerstown (Thomas) Coal and 10 to 20 feet above the top of the Buffalo Sandstone, is a marine member that has proved to be of much value in the correlation of Conemaugh stratigraphy. So far as known the presence of marine fauna at this stage was not recorded in the Potomac Valley until work began on the territory of this report and a persistent search was made to establish its proper horizon. As already stated in connection with the general section of the Conemaugh it had been held by members of the Maryland Survey that the proper position of this limestone (often known as "Cambridge") lay between the two Bakerstown Coals, but the writer was unable to find a marine fauna between these two coals and on the other hand, located the fossiliferous zone below the lower coal at precisely the same position it occupies in western Pennsylvania and northern West Virginia where its correlation has not been disputed. As recorded in the Piedmont Section, page 156, these fossils were found on the south side of North Branch of Potomac River in a small ravine directly opposite the pulp-mill at Luke, coming 17 feet below the (Lower) Bakerstown Coal and 13 feet above the top of the Buffalo Sandstone which is massive in that locality, and being one foot thick, siliceous,

and ferruginous, and carrying abundant marine fauna. Fossils were also observed in a landslide along the public road one-fourth mile farther southwest where no opportunity for measurement to members above and below was afforded. Elsewhere in the Potomac Valley no fossils were found at this horizon, there being apparently only a few points where the strata directly below the Bakerstown Coal are exposed. They are partially visible, however, on the north side of the Potomac 0.4 mile west of the mouth of Georges Creek, in the public road on the east side of Deep Run 0.2 mile south of Shaw, at an exposure of the Bakerstown Coal on the east side of Deep Run at the highway bridge 0.4 mile south of Nethken, and at the top of the Grafton Mining Company plane to the Bakerstown Coal just south of Blaine.

A discussion of the fossils collected at the locality just opposite Luke, as identified by Dr. John L. Tilton, will be found in Chapter XXI.

The following is a list of species identified:

Orthotetes (Derbya) robustus Hall
Productus cora d'Orbigny
Lingula umbonata Cox
Orbiculoidea convexa Shumard
Aviculopecten
Edmondia.

MEYERSDALE RED SHALE.

The **Meyersdale Red Shale** of the Maryland Survey, lying just over the Buffalo Sandstone and therefore occupying the interval between that stratum and the Pine Creek Limestone, does not appear to be prominent in Mineral and Grant Counties, its horizon being almost, if not entirely, occupied by sandy shale broken by an occasional thin streak of sandstone.

BUFFALO SANDSTONE.

The **Buffalo Sandstone,** having its base 40 to 50 feet below the Pine Creek Limestone and about 135 feet above the Upper Freeport Coal, is a regular and consistent member of the Conemaugh of the two counties. As a rule it is gray, massive, medium-hard and medium-coarse, its thickness varying from 20 to 45 feet, and it frequently makes prominent cliffs. In Chapter V it is noted in the Piedmont Section as 45 feet thick and a massive cliff, in the Bloomington Section as 45 feet thick and massive, in the Hampshire Section as 30 feet thick and massive, in the Barnum Section as 40 feet thick, in the Shaw Section as a massive cliff of which 25 feet is visible, in the Elk Garden Section as 25 feet thick

and massive, in the Gleason Section as massive and 37 feet thick but partly concealed, in the Hubbard Section as 30 feet thick and massive, and in the Schell Section as 25 feet thick and massive. On Abram Creek, Mineral County, it is also prominent just above the Mapleville Coal Company tipple, 0.8 mile east of Oakmont, where 25 feet of it is exposed above drainage. On Stony River, Grant County, there is 15 feet of it visible above drainage at the mouth of Eye Run, 1 mile northwest of Mount Storm. In Chapter XVII it is recorded in many coal test borings. So far as known this sandstone has not been quarried in either county. It would make a fair quality of building stone but experience with it elsewhere has shown that it splits irregularly and has a tendency toward somewhat rapid weathering owing to minute cleavage-planes and included alumina.

BRUSH CREEK SHALE AND LIMESTONE.

The **Brush Creek Shale and Limestone**, coming just under the Buffalo Sandstone and 120 to 135 feet above the Upper Freeport Coal, is another important marine member of the Conemaugh in Mineral and Grant Counties, as well as in other wide-spread regions where the series outcrops. In the territory of this Report it is usually a black, fissile shale, sometimes containing small lenses of ferruginous limestone, its thickness varying from 5 to 10 feet. At some localities it contains many small, invertebrate fossils, among which **Chonetes verneuilianus** has been recorded by members of the Maryland Survey as characteristic, together with the almost complete absence of **Ambocoelia planoconvexa** in eastern sections. At other localities it seems to be practically barren of fauna of any sort, and its horizon is often concealed by debris, so that it can be found and directly identified only at a few points in the valley.

In Chapter V the shale is noted in the sections for Piedmont, Hampshire, Barnum, Elk Garden, Hubbard, and Schell, fossils having been observed at several of these localities. Fossils were also found on Franklin Hill, Allegany County, Maryland, 0.4 mile west of the mouth of Georges Creek, at an elevation of 1183′ B.; also on the hill just southeast of the Piedmont city reservoir, Mineral County, at an elevation of 1330′ B.; also in the saddle between Cranberry and Howell Runs, Mineral County, 1.7 miles southeast of Nethken, at an elevation of 2560′ B., where its identification is subject to doubt as its stratigraphic associations are not apparent; and also in Grant County at Coal Exposure No. 251,

on the west side of Abram Creek, at an elevation of 2490′ B.

In Chapter XXI will be found lists of fossils collected by the writer at several localities, together with remarks on the same by Dr. John L. Tilton.

The following is a summary of all species noted in Mineral County, including one collection in Allegany County, Maryland, just opposite Piedmont:

Lingula carbonaria Shumard
Cardiomorpha missouriensis Shumard ?
Leda meekana Mark ?
Bellerophon crassus var. wewokanus Girty
Nucula parva McChesney
Edmondia (?)
Plagiostoma acosta Cox
Igoceras (?)
Ostracoda (four species including a Leperditia)
Gastropoda (minute fragments)
Insecta (impression suggestive of a wing).

BRUSH CREEK COAL.

The **Brush Creek Coal,** coming just under the Brush Creek Shale and approximately 120 to 135 feet above the Upper Freeport Coal, is a thin and lenticular bed, usually only a few inches thick and without economic interest but important from a scientific viewpoint owing to its value in the search for fossils in the shale. It was observed at **Exposure No. 247 on Map II,** in Allegany County, Maryland, on Franklin Hill, 0.4 mile west of the mouth of Georges Creek, at an elevation of 1182′ B., being 0′ 9″ thick; also at **Exposure No. 248 on Map II,** on the south side of North Branch, Mineral County, 0.2 mile south of Luke, at an elevation of 1365′ B., and with a thickness of 0′ 4″, as recorded in the Piedmont Section; also at **Exposure No. 249 on Map II,** on the west side of Piney Swamp Run, Mineral County, 0.7 mile southwest of Hampshire, at an elevation of 1200′ B., where its blossom is visible, as detailed in the Hampshire Section; also at the **Hubbard Coal Mining Company Exposure (No. 250 on Map II),** on the north side of North Branch, Garrett County, Maryland, 0.4 mile northwest of Hubbard, at an elevation of 2315′ B., where it is represented by a blossom as shown by the Hubbard Section; and also at the following exposure in Grant County:

W. H. Kitzmiller Exposure—No. 251 on Map IV.

On the west side of Abram Creek, 2.5 miles northeast of Mount Storm; **Brush Creek Coal;** elevation, 2490′ B.

	Ft.	In.
Shale, dark, sandy, with marine fossils, **Brush Creek**	10	0
Coal	0	3
Shale, sandy		

BRUSH CREEK FIRE CLAY SHALE.

The **Brush Creek Fire Clay Shale,** coming just under the Brush Creek Coal, is usually represented in Mineral and Grant Counties by impure, sandy shale, with thin lenses of sandstone, in contrast to its more consistently aluminous character in the Monongahela Valley.

UPPER MAHONING SANDSTONE.

The **Upper Mahoning Sandstone,** coming 15 to 25 feet below the Brush Creek Coal and a few feet above the Mahoning ("Six-foot") Coal, is a prominent stratum in Mineral and Grant Counties. As a rule it is massive, gray, hard and coarse, frequently making prominent cliffs and varying from 10 to 65 feet, its average being perhaps 40 feet. In Chapter V it is recorded in the Piedmont Section as 65 feet thick and massive, in the Westernport Section as 30 feet thick and massive, in the Bloomington Section as 30 feet thick and massive, in the Hampshire Section as 10 feet thick, in the Elk Garden Section as 30 feet thick and massive, and in the Hubbard Section as 10 feet thick. In Chapter XVII it is noted in numerous detailed sections of the Mahoning ("Six-foot") Coal and in many coal test borings. So far as known it has not been quarried in either county but would furnish a great amount of durable building stone for rough masonry if desired.

SUTTON LIMESTONE.

The **Sutton Limestone** of Braxton County, West Virginia, coming just under the Upper Mahoning Sandstone, and being of fresh- or brackish-water origin, was not observed at outcrop in either county, but is recorded as one foot thick in the Henry Section, page 185.

MAHONING RED SHALE.

The **Mahoning Red Shale,** belonging between the Sutton Limestone horizon and the Mahoning ("Six-foot") Coal, is a lenticular bed, usually less than five feet in thickness, that recurs at intervals throughout the valley, being of special scientific interest because of the fact that it is the lowest stratigraphic horizon where reds occur in the Conemaugh Series. It was not observed at outcrop in either county, but it is recorded in the Wilson Section, page 181, as 4 feet thick, and in the Wilsonia Section, page 189, as 7 feet thick, having been pierced by bore holes at both of these localities. It is

also visible at outcrop near Douglas, Tucker County, a few miles southwest of Fairfax Knob.

MAHONING ("SIX-FOOT") COAL.

The **Mahoning ("Six-foot") Coal,** coming a few feet below the Upper Mahoning Sandstone, and 40 to 50 feet above the Upper Freeport Coal, is a soft, multiple-bedded deposit, usually containing a few streaks of slate or bone. In the vicinity of Piedmont it has a maximum thickness of about six feet but in passing up the Potomac it thins down gradually until, in Grant County, it is seldom more than one foot thick and often entirely absent. For many years this coal has been mined under the trade name of Upper Kittanning ("Six-foot"), under the mistaken impression that it was a member of the Allegheny Series, but its position of only 70 to 80 feet below the fossiliferous Brush Creek Shale places it undoubtedly in the Conemaugh and its interval of 40 to 50 feet above the "Split-six" Coal, which seems beyond question to be the true Upper Freeport, fixes its horizon as that of the Mahoning, although members of the Maryland Survey have preferred to call it the "Piedmont Coal," and to assign the Mahoning Coal to a horizon a few feet farther up in the Conemaugh. As stated in remarks following the General Section of the Conemaugh Series at the beginning of this Chapter, no trace of any other coal between this horizon and the Brush Creek Coal was found in the valley and it is therefore considered to belong more properly at the Mahoning level.

In Chapter XVII will be found a further discussion of this coal, with detailed sections, chemical analyses, and estimates of tonnage.

THORNTON FIRE CLAY.

The **Thornton Fire Clay,** coming just under the Mahoning Coal, is of small importance in Mineral and Grant Counties, its horizon being usually occupied by sandy or carbonaceous shales. In Garrett County, Maryland, however, just northwest of Hubbard, there is 40 feet of shale containing a mixture of flint fire clay and iron ore, in the point above the top of the Hubbard Coal Mining Company incline, that belongs at the Thornton horizon. Owing to the presence of iron it does not seem probable that this bed of shale could be utilized to much value.

LOWER MAHONING SANDSTONE.

The **Lower Mahoning Sandstone,** coming a few feet below the Mahoning ("Six-foot") Coal and a few feet above the Upper Freeport ("Split-six") Coal, is a massive, hard, gray, coarse stratum, varying in thickness from 10 to 40 feet but being usually about 25 feet. In Chapter V it is recorded in the Piedmont Section as 10 feet thick and massive, in the Bloomington Section as 23 feet thick and shaly, in the Luke Section as 8 feet thick and shaly, in the Hampshire Section as 16 feet thick and shaly, in the Barnum Section as 38 feet thick and massive, and in the Hubbard Section as 10 feet thick and massive. In Chapter XVII it is also noted at many sections of the Upper Freeport Coal and in many coal test borings which have passed through it. So far as known it has not been quarried in either county but at numerous points it could be utilized for rough masonry structures if desired.

UFFINGTON SHALE.

The **Uffington Shale,** coming between the Lower Mahoning Sandstone and the Upper Freeport Coal, and being usually dark, sandy, and frequently carbonaceous, with a thickness of 5 to 10 feet, is present in the valley at some localities while at others it is entirely absent, allowing the sandstone to rest directly on the coal. Its position is illustrated in the Bloomington Section, page 160, where it is 4½ feet thick, and in Chapter XVII it is also noted in various detailed sections of the Upper Freeport Coal, as well as in several coal test borings.

For many years this shale was regarded as marine in character, owing to the supposed presence of fossils at its type locality in Monongalia County, but studies in recent years by Dr. W. A. Price have proved that the collection of fossils made at Uffington came from the Brush Creek Shale horizon at a higher level in the Conemaugh, and that a persistent search in the true Uffington Shale revealed no marine remains.

ECONOMIC ASPECTS, CONEMAUGH SERIES.

From an economic standpoint the Conemaugh Series is of value because of its commercial coals, of which there are seven, as already mentioned. It also contains several beds of shale that could be utilized for the manufacture of building brick and several sandstone ledges from which building

stone in large quantity may be obtained. It has no pure fire clays suitable for refractory purposes and no limestones of sufficient thickness and purity to be used, and no other mineral substances of present known value except those already mentioned, save that its shales disintegrate into good agricultural soil.

CHAPTER VIII.

STRATIGRAPHY---ALLEGHENY SERIES.

GENERAL ACCOUNT AND SECTION, ALLEGHENY SERIES.

The Allegheny Series of the Pennsylvania Period is an important unit of the rock system of both Mineral and Grant Counties in the region west of the Allegheny Front. Starting with the Upper Freeport ("Split-six," "Davis") Coal just below the base of the Conemaugh Series it extends downward to the top of the Homewood Sandstone, the upper member of the Pottsville, its total thickness varying from 150 to 200 feet with an average of about 175 feet. It is composed of alternate strata of sandstone, sandy shale, or impure fire clay, coal, and impure or ferruginous limestone, there being six coal beds of which three are sometimes of minable thickness. The following general section, compiled from the measured sections of Chapter V, as well as from scattered local observations and coal test borings, and arranged in descending order, shows the sequence and main characteristics of its individual members, its content from a lithologic standpoint being composed approximately of 60.00 per cent. of sandstone, 21.14 per cent. of sandy shale or fire clay, 10.29 per cent. of coal, and 8.57 per cent. of limestone:

General Section of the Allegheny Series for Mineral and Grant Counties.

	Thickness. Feet.	Total. Feet.
Shale, Uffington, basal member of Conemaugh Series.....	....	.....
Coal, Upper Freeport ("Split-six," "Davis"), soft, multiple-bedded, with streaks of shale or bone, 4′ to.....	8	8
Fire clay, Bolivar, usually represented by sandy shale, impure and worthless, 0′ to.....	5	13
Limestone, Upper Freeport, lenticular and impure, 0′ to..	5	18
Sandstone, Upper Freeport, gray, massive, hard, coarse, 15′ to	20	38
Coal, Lower Freeport, lenticular and worthless, 0′ to.....	2	40

	Thickness. Feet.	Total. Feet.
Fire clay, Lower Freeport, impure, 0′ to	7	47
Sandstone Lower Freeport, gray, massive, hard, coarse, makes cliffs, 25′ to	40	87
Coal, Upper Kittanning, soft, single- or double-bedded, 1′ to	3	90
Fire clay, Upper Kittanning, usually sandy and impure	5	95
Limestone, Johnstown, ferruginous, lenticular, non-marine, 0′ to	5	100
Fire clay, Hardman, usually sandy and impure	6	106
Sandstone, Upper East Lynn, seldom present, 8′ to	0	106
Coal, Middle Kittanning, lenticular, seldom found, 0′ to	1	107
Sandstone, East Lynn, gray, massive, hard, coarse, carries reptile tracks (**Dyscritichnus piedmontensis**) near Bloomington, Maryland, 25′ to	30	137
Coal, Lower Kittanning, soft, double-bedded, 2′ to	3	140
Fire clay, Lower Kittanning, sometimes flinty, but usually sandy and impure, 5′ to	9	149
Limestone, Vanport (Ferriferous), ferruginous, lenticular, apparently non-marine in this area, 1′ to	5	154
Sandstone, Kittanning, gray, lenticular, 0′ to	15	169
Coal, Clarion, lenticular, seldom found, 0′ to	1	170
Shale, dark or sandy	5	175
Sandstone, Homewood, (outcropping at the mouth of Georges Creek), top of Pottsville Series	....	.....

In presenting the above general section of the Allegheny attention is called to its radical difference from many previous conceptions of this group in the Potomac Valley. As explained in remarks following the general section of the Conemaugh Series in Chapter VII it was long believed that the Allegheny extended up to and included the coal lying about 200 feet above the "Split-six" or "Davis" Coal and that it therefore had a greater thickness along the Potomac than in western Pennsylvania and the more western counties of northern West Virginia, but as further explained therein the discovery in recent years of the three principal marine zones of the Conemaugh has made it certain that the coal formerly described as the Freeport is the true Bakerstown of Pennsylvania and that the "Split-six," or "Davis" Coal, instead of being the Lower Kittanning, is the true Upper Freeport, and that the Allegheny is of less thickness on the Potomac than at its type locality in western Pennsylvania. The discovery of this error and the consequent readjustment of the Allegheny column reveals the fact that a decided decadence or atrophy has occurred at the stage of the Kittanning Coals which, while still present, are relatively thin and unimportant as compared to some other regions.

Credit for the discovery of most of the Conemaugh fossil zones in this valley belongs primarily to Dr. C. K. Swartz and

others working under the auspices of the Maryland Survey,[1] who have already presented the essential data in concise form. The revised relationships have also been indicated and discussed by the writer in the Tucker County Report of the West Virginia Survey, and while prosecuting field work in Mineral and Grant Counties a special attempt was made to show to coal operators, owners, and other interested parties the necessity for change in the nomenclature of coals which have long been known and mined under trade names that are considered of value.

While members of both Surveys are agreed as to the top of the Allegheny they are not yet in full accord as to its base. Dr. Swartz and his associates have advanced the view, based largely on the evidence of fossil plants, that the end of the series may belong more properly at the base of the Mount Savage Coal Stage of Pennsylvania and Maryland and at the top of the Sampson Rock Conglomerate. The writer believes, however, that the Mount Savage Sandstone correlates with the Homewood of the various Pennsylvania Geological Surveys, as it has been traced by many investigators from its type locality in Beaver County, Pennsylvania, eastward to the Mount Savage region of the Georges Creek Basin, and that the Mount Savage Coals belong at the Mercer Coal Stage of western Pennsylvania, the deduction necessarily following that the Sampson Rock Conglomerate lying below these coals is the Upper Connoquenessing of Beaver County. As explained in the Tucker County Report the entire Allegheny Series is present with its full normal thickness, and with practically all of its coals and other distinctive beds in Monongalia, Marion, Taylor, Barbour, Randolph, and Upshur Counties, and in all of these counties the Homewood Sandstone of the Pottsville occurs just below the Allegheny, with its typical and easily recognized lithology and plant life, followed in turn by the Mercer Coals and Fire Clays, which are then followed by the Upper Connoquenessing Sandstone, the distinctive lithology and plant life of which varies but little from place to place. Recognition of the view that the Mount Savage stage belongs in the Allegheny would involve the removal of 100 feet or more of apparently typical Pottsville sediments and would place in the Allegheny Series of the counties named several coals which can not be so included without the introduction of new titles, resulting in endless confusion. In view of the reasons stated above, the base of the Allegheny in Mineral and Grant Counties is placed at the

[1] C. K. Swartz, W. A. Price and Harvey Bassler, Bull. Geol. Soc. Am., Vol. 30, pp. 567-596; 1919.

top of the Homewood Sandstone as heretofore recognized and described in northern West Virginia, there being a prominent outcrop just above drainage at the mouth of Georges Creek, opposite Piedmont, another at the highway bridge across the Potomac just east of Luke, and another at Schell below the mouth of Stony River.

TOPOGRAPHIC EXPRESSION, ALLEGHENY SERIES.

In topographic expression the Allegheny Series, when uninfluenced by extraneous factors, usually produces rounded ridges and moderately gentle slopes that bulge distinctly outward, several wide benches being made by its hard sandstones as subordinate details of the general effect. In Mineral and Grant Counties, however, it is largely covered by a thick mantle of Conemaugh sediments, its full outcrop being seldom found except along major drainage channels where it makes only a portion of the slopes. In these localities its sandstones often stand out in ledges of short extent but are seldom traceable for long distances without other supporting data.

AREAL EXTENT, ALLEGHENY SERIES.

The Allegheny Series outcrops in whole or in part along the deep valley of North Branch of Potomac River almost continuously from Piedmont, Mineral County, southwestward to a point one-half mile east of Gormania, Grant County, as well as for short distances on some of its major tributaries. It is also exposed in full in a narrow belt lying about one-half mile west of, and parallel to the escarpment of the Allegheny Front, and extending from the vicinity of Piedmont southwestward across both Mineral and Grant to the Tucker County Line, and along the uplift of the Blackwater Anticline in the Stony River drainage area of Grant County there are other outcrops of considerable extent. Its areal limits are indicated on Maps II and IV, to which reference may be made for additional details. By far the best opportunity for its study is afforded directly along the Potomac, as the outcrop near the Allegheny Front is on rising strata in a plateau country where vertical sections can not be made and in the Stony River region it is much concealed by debris.

CONTACTS, ALLEGHENY SERIES.

The upper contact of the Allegheny Series with the Conemaugh has already been discussed in the Chapter on the latter series, page 209. Its lower contact with the Pottsville has been mentioned, also, in remarks following the General

Section of the Allegheny, page 235. At this zone there is no marked unconformity but there is an apparently rapid change in plant life from the typical flora of the Allegheny to that of the Pottsville, taking place in a transitional rather than in an abrupt manner, and there is also a visible lithologic difference in the sandstones, which in the Pottsville become much more massive and coarse with attendant inclusions of quartz pebbles, these latter being the exception rather than the rule in the Allegheny ledges.

FOSSIL LIFE, ALLEGHENY SERIES.

Invertebrate fossil remains were not observed in the Allegheny of Mineral and Grant Counties. In western Pennsylvania and Ohio, however, there is an abundant marine fauna reported in the Vanport (Ferriferous) Limestone coming between the Lower Kittanning Coal and the Homewood Sandstone. This limestone is apparently identified in the vicinity of Piedmont but a patient search revealed no trace of marine organisms and Dr. Swartz and his associates of the Maryland Survey are authority for the statement that the fossils extend only a few miles east of Pittsburgh. So far as known only one other instance of invertebrate marine fauna in the Allegheny has been observed, the same being the occurrence of an unidentified species of **Lingula** in the roof shales of the Lower Kittanning Coal in Barbour County, West Virginia.[2]

In the Potomac Valley, however, there is a most interesting occurrence of vertebrate reptile footprints, coming on the top of the East Lynn Sandstone at an exposure on the northern bank of North Branch of Potomac River about one-half mile south of Bloomington, Maryland, and about one-third mile northeast of Hampshire, Mineral County. The existence of these tracks has been known for many years but they were not given expert scientific attention until the fall of 1921 when Dr. R. S. Lull of Yale University examined them under the auspices of the West Virginia Survey and pronounced them to be of apparently true organic origin. Dr. Lull's paper and conclusions on these tracks will be found in Chapter XXI where all paleontologic data are assembled for convenience.

Plant life in the Allegheny Series is abundant but no study of it in Mineral and Grant Counties has been made by the Survey.

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[2] David B. Reger, Barbour, Upshur and Western Portion of Randolph County Report, W. Va. Geological Survey, p. 558; 1918.

DESCRIPTION OF MEMBERS, ALLEGHENY SERIES.

UPPER FREEPORT ("SPLIT-SIX", "DAVIS") COAL.

The **Upper Freeport Coal,** coming at the top of the Allegheny, is by far its most interesting as well as most valuable member. As explained in the beginning of this Chapter and elsewhere, this coal has long been improperly identified in the Potomac Valley, its horizon having been placed at that of the Bakerstown Coal nearly 200 feet above its true level, while the true Upper Freeport has been classified as the Lower Kittanning and at the same time has borne the local titles of **"Split-six"** and **"Davis,"** the former referring to its frequent condition in the valley and the latter to the mining region in Tucker County. There has always been a moot question as to whether the "Split-six" of the Potomac Valley proper was the same coal as the "Davis" of Tucker County but after the recent intensive studies of both Maryland and West Virginia, members of both Surveys are in full agreement that they are the same bed, the previous confusion and doubt on this point having been due to the fact that the Mahoning ("Six-foot") Coal of the Piedmont region thins out and practically disappears in passing up the Potomac, while at the same time the Upper Freeport ("Split-six", "Davis"), which at Piedmont is very thin, becomes a valuable minable bed at Hampshire and so continues all the way up the valley. At Hampshire, however, both coals have been opened in the same hillside and have been connected by vertical measurement to the fossiliferous Brush Creek Shale, as shown by the Hampshire Section, pages 163-4, thus proving the existence of two coals instead of one as sometimes supposed. There is also much corroborative evidence at many other points although none of it is of equal value with that found at Hampshire.

The Upper Freeport ("Split-six," "Davis") Coal is a soft, multiple-bedded seam with streaks of shale or bone, its total thickness varying usually from 4 to 8 feet. In several localities one of the shale beds near the middle thickens to several feet, giving rise to the title of "Split-six" which it often carries. It has been mined extensively for many years in both counties so that abundant opportunity is afforded to study its cross-section and many borings have been made through it in regions where it lies below drainage. Its outcrop, as delineated on Maps II and IV, extends from Piedmont southwestward almost continuously up North Branch to a point about one-half mile east of Gormania, Grant County, and also reaches up some of the tributary streams, there being many miles of exposure on Stony River. It also outcrops in a long

irregular line a short distance northwest of the escarpment of the Allegheny Front where the rise of the strata brings it above the plateau surface, but in this region there are only scattered openings where it has been used for domestic fuel. In Chapter XVII it will be discussed in detail, with chemical analyses, mine sections, and estimates of tonnage, under the subject of "Commercial Coal," and in the same Chapter its presence in many coal test borings is recorded.

BOLIVAR FIRE CLAY.

The **Bolivar Fire Clay,** coming just under the Upper Freeport Coal, appears to be poorly represented in Mineral and Grant, its horizon being usually occupied by sandy shale or sandstone. In the Bloomington Section, page 160, there is 10 feet of fire clay shale with limestone, coming just under the coal and apparently being the Bolivar Clay in close association with the Upper Freeport Limestone. Judging from the infrequency of its outcrop in pure form it offers little or no opportunity for commercial exploitation.

UPPER FREEPORT LIMESTONE.

The **Upper Freeport Limestone,** coming a few feet below the Upper Freeport Coal and just beneath the horizon of the Bolivar Fire Clay, appears to be largely absent from Mineral and Grant Counties. Its best exposure in the region is along the Baltimore and Ohio Railroad grade, one mile northwest of Bloomington, Garrett County, Maryland, where there is 10 feet of interbedded fire clay shale and limestone, representing the Bolivar Fire Clay and the limestone in conjunction. It is also visible in the form of nodules bedded in shale at the New Creek mine of the Masteller Coal Company on the west side of Piney Swamp Run, one-half mile southwest of Hampshire, Mineral County. In Grant County it is again visible in the bluff east of Stony River, 2.8 miles west of Bismarck, being 0′ 8″ thick and coming 6 feet below the Upper Freeport Coal (at Coal Exposure No. 326 on Map IV). This limestone appears to be entirely of fresh- or brackish-water origin, no marine fauna being recorded in it at any known locality of its outcrop.

UPPER FREEPORT SANDSTONE.

The **Upper Freeport Sandstone,** coming at a variable interval of 5 to 20 feet below the Upper Freeport Coal, is a gray, massive, hard, coarse stratum, varying in thickness from 10 to 40 feet, its average being perhaps 20 feet. In Chapter V it is recorded in the Bloomington Section as 30 feet

thick, in the Barnum Section as 40 feet thick, and in the Schell Section as 10 feet. In Chapter XVII it is recorded in various coal test borings. So far as known it has not been quarried but if desired it would furnish rough building stone of a durable character.

LOWER FREEPORT COAL.

The **Lower Freeport Coal**, coming just beneath the Upper Freeport Sandstone and about 40 feet below the Upper Freeport Coal, is represented in Mineral and Grant by a lenticular bed, nearly always less than two feet in thickness and likewise impure and apparently worthless. In Mineral County it was observed only at **Exposure No. 347 on Map II**, on the east side of North Branch, 0.2 mile northeast of Schell, where its blossom is visible at an elevation of 2230′ B., as recorded in the Schell Section. In Grant County it is visible at the **Herr & Company Exposure (No. 348 on Map IV)**, on the northeast side of Stony River, 2.8 miles west of Bismarck, at an elevation of 3010′ B., being only 0′ 4″ thick. It was once opened, also, at the **Benjamin F. Hanlin Prospect (No. 349 on Map IV)**, on the head of Laurel Run of Stony River, 0.1 mile southeast of the Grassy Ridge School, at an elevation of 3370′ B. This prospect had fallen shut, the thickness of the coal as reported by J. W. Mahaffey being 2½ feet. The following exposure was observed on the Maryland side of the Potomac:

Western Maryland Railway Exposure—No. 350 on Map IV.

Garrett County, Maryland, on the north side of North Branch of Potomac River, just west of Steyer; **Lower Freeport Coal**; elevation, 2320′ B.

	Ft.	In.
Sandstone, **Upper Freeport**, visible	3	0
Shale, sandy	5	0
Coal, slaty	1	0
Fire clay shale, to grade	5	0

In Garrett County, also, it is visible again at the **Western Maryland Railway Exposure (No. 351 on Map IV)**, 0.3 mile west of Steyer, at an elevation of 2320′ B., there being only a blossom at this point. In Grant County, again, it was once opened at the **J. W. Brock Prospect (No. 352 on Map IV)**, on the south side of the Potomac, 0.4 mile southwest of Steyer, at an elevation of 2365′ B. This place had fallen shut, no report being obtained as to its thickness.

LOWER FREEPORT FIRE CLAY.

The **Lower Freeport Fire Clay**, coming just under the Lower Freeport Coal in Tucker County where it is a flinty

Photo by E. E. HARRIS.

PLATE XII.—View from road between Reeses Mill and Alaska, looking west across valley of Patterson Creek. Hamilton and Genesee in level ground. Portage in low wooded hills. Oriskany Sandstone and New Scotland Chert form the knobs of Knobly Mountain in rear.

deposit, appears to be impure and worthless in Mineral and Grant, its horizon being occupied by sandy shale.

The **Lower Freeport Limestone,** which in some regions is found at about the same horizon as the Lower Freeport Fire Clay, was not observed in either county.

LOWER FREEPORT SANDSTONE.

The **Lower Freeport Sandstone,** coming 5 to 10 feet below the Lower Freeport Coal, is a hard, massive, gray, coarse stratum, varying in thickness from 25 to 40 feet, and occasionally making bold cliffs. In Chapter V it is recorded in the Piedmont Section as 20 feet thick and massive, in the Luke Section as 38 feet thick and a massive cliff, in the Savage River Section as 40 feet thick and massive, in the Bond Section as 10 feet thick and massive, in the Elk Garden Section as 50 feet thick and a massive, pebbly cliff, and in the Hubbard Section as 15 feet thick and massive. In Allegany County, Maryland, it makes a great cliff, 40 feet thick, for a considerable distance along the highway between Luke and the mouth of Savage River, and in Mineral County it is visible above the Western Maryland Railway grade just south of the crossing of this road beneath the Baltimore and Ohio viaduct across North Branch near Franklin. It is again visible on the east side of North Branch, 0.4 mile north of Windom, making a 50-foot cliff, and at Windom and for three-fourths of a mile southward it is prominent, being partly above drainage. At the south end of Neffs Siding, 0.6 mile north of Chaffee, it is a massive cliff, 25 feet thick and coming 40 feet above the Lower Kittanning Coal, and southward from that point to Chaffee there are several exposures, a maximum of 50 feet being visible. On the east side of North Branch in the locality just north of Harrison there are several exposures, coming a few feet above the Upper Kittanning Coal and exhibiting a thickness of about 30 feet, the outcrop being also visible on the north side of the mouth of Abram Creek. In Chapter XVII it is also noted at several exposures of the Upper Kittanning Coal and in the records of a few coal test borings.

At the **William A. Brydon Estate Quarry,** located in Garrett County, Maryland, just east of Bloomington and just south of the Baltimore and Ohio Railroad viaduct across North Branch, the Lower Freeport Sandstone was once operated extensively, there being 20 feet of massive, gray, and very hard, but somewhat broken stone visible above a stratum of fire clay shale. Here the ledge has been quarried for a linear distance of about 300 feet along the outcrop and at some points for as much as 150 feet into the sloping bench

above it. The product was used for paving block and furnace lining, being reported as highly refractory.

It was also quarried at another locality on the same estate, 0.4 mile south of Bloomington, being of much the same character and having been used for the same purposes.

Judging from the results obtained at these two quarries, as well as from general observations, this ledge should furnish a vast amount of stone for commercial purposes.

UPPER KITTANNING COAL.

The **Upper Kittanning Coal,** coming just under the Lower Freeport Sandstone and 70 to 100 feet below the Upper Freeport Coal, is a soft, single- or double-bedded deposit, sometimes having a thin streak of slate or bone near the middle but usually being clean, with a thickness varying from 1 to 3 feet. This coal has never been definitely correlated in the Potomac Valley, being sometimes mentioned as the "Clarion", although that title has been more often applied to the true Lower Kittanning. The Upper Kittanning in Mineral and Grant Counties has not been mined commercially but in Garrett County, Maryland, just northeast of Hampshire, it has been developed on a small scale. At many points in the two counties it is lenticular but at others it exhibits a fair thickness of good coal and is therefore a fuel resource of some value and its further discussion will be reserved for Chapter XVII where detailed sections, chemical analyses, and estimates of tonnage will be presented under the subject of "Commercial Coal."

UPPER KITTANNING FIRE CLAY.

The **Upper Kittanning Fire Clay,** belonging just under the Upper Kittanning Coal and being a valuable flinty bed in some portions of the State, is poorly represented in Mineral and Grant, where its horizon is usually occupied by sandy shale with only rare occurrences of flint clay. At Coal Exposure No. 363, on the east side of North Branch, about one-third mile northeast of Harrison, there is 13 feet of plastic fire clay, intermingled with ferruginous limestone, that is probably a combination of the Upper Kittanning and Hardman Fire Clays with interbedded lenses of Johnstown Limestone, which belongs between them. On the east side of North Branch, 0.6 mile southwest of Harrison, there is another exposure of the same clay along the Western Maryland Railway grade. Here it is also interbedded with the ferruginous limestone but is flinty, being 5 feet thick. At certain other points there are exposures of plastic clay below the

Upper Kittanning Coal, these being noted in connection with sections of the coal published in Chapter XVII.

JOHNSTOWN LIMESTONE.

The **Johnstown Limestone**, coming just under the Upper Kittanning Fire Clay and only a few feet below the Upper Kittanning Coal, was observed at several localities in the two counties, being usually ferruginous and impure and often lenticular or nodular in its deposition, its thickness sometimes attaining 5 feet. So far as known it is entirely nonmarine in character, in these as well as in other counties. In Chapter V it is recorded in the sections for Luke, Bond, Elk Garden, and Schell. It is plainly exposed in a highway cut just southeast of the mouth of Savage River in Allegany County, Maryland, being about 3 feet thick, shaly, and ferruginous, and coming just under the Upper Kittanning Coal. It was also noted along the Western Maryland Railway above and below Harrison, as described in connection with the Upper Kittanning Fire Clay, and on the east side of North Branch, 0.6 mile northwest of Elk Garden there is an exposure of 20 feet of shale containing ferruginous limestone that seems to represent it, at an elevation of 1562′ B. It appears probable, also, that the old, abandoned iron ore pit on the land of Dr. Z. T. Kalbaugh, on the north side of Mine Ridge between branches of Howell Run, 2.2 miles southeast of Shaw, at an elevation of 2525′ B., may be the Johnstown horizon, although outcrops at this locality are now totally obscured and also no opportunity for its identification by vertical section is afforded. This outcrop will be further discussed in Chapter XIX under the subject of "Iron Ore."

HARDMAN FIRE CLAY.

The **Hardman Fire Clay**, coming just under the Johnstown Limestone and 15 to 25 feet below the Upper Kittanning Coal, appears to be sandy and impure at most localities in the two counties. As mentioned under the Upper Kittanning Clay it seems to be represented at exposures along the Western Maryland Railway grade above and below Harrison, Mineral County.

UPPER EAST LYNN SANDSTONE.

The **Upper East Lynn Sandstone**, belonging between the Hardman Fire Clay and Middle Kittanning Coal, was not observed at outcrop at any point in either county and appears to be almost entirely absent from the measures in most of the territory. It was found, however, in the Davis Coal and

Coke Company No. 73 Coal Test Boring (No. 74 on Map IV) located at Henry, Grant County, the record of which is published as the Henry Section, page 186. Here the sandstone is eight feet thick, coming above the Middle Kittanning Coal.

MIDDLE KITTANNING COAL.

The **Middle Kittanning Coal,** belonging just under the Upper East Lynn Sandstone and 20 to 25 feet below the Upper Kittanning Coal, appears to be largely absent from the measures in the two counties, no exposure having been noted at outcrop. In the Davis Coal and Coke Company No. 73 Coal Test Boring (No. 74 on Map IV.) located at Henry, Grant County, the record of which is published as the Henry Section, page 186, this coal was found with a thickness of 1′ 5½″, being slaty and impure and coming about 14 feet above the Lower Kittanning Coal.

EAST LYNN SANDSTONE.

The **East Lynn Sandstone,** belonging between the Middle and Lower Kittanning Coals, is a prominent member of the Allegheny Series of the two counties. As a rule it is gray, massive, hard, and coarse, varying in thickness from 10 to 50 feet, but being usually 25 to 30 feet, and making many conspicuous cliffs. In Chapter V it is recorded in the Westernport Section as 34 feet thick and a massive cliff, in the Piedmont Section as 30 feet thick and massive, in the Luke Section as 30 feet thick and massive, in the Bond Section as 15½ feet thick and massive, in the Elk Garden Section as 50 feet thick and a massive cliff, and in the Schell Section as 54 feet thick but only partly exposed. In Chapter XVII it is noted in various sections of the Lower Kittanning Coal. In the vicinity of Piedmont it is well exposed at numerous points, being prominent on the north side of the Potomac southeast of Westernport where it is a conspicuous white cliff in the end of Dans Mountain. It forms the bed of North Branch at the mouth of Savage River and thence rises southward, there being 10 feet of it visible above drainage at the highway bridge just east of Bloomington and 17 feet at the east end of the Baltimore and Ohio Railroad viaduct across North Branch, and on the Maryland side of North Branch just northeast of Hampshire its top is visible 5 to 10 feet above drainage. In the bed of North Branch just west of the mouth of Piney Swamp Run it is visible and at the south end of Neffs Siding it makes a 30-foot cliff, coming just over the Lower Kittanning Coal. On the east side of North Branch, 0.6 mile northwest of Elk Garden, it is 30 feet thick, having an elevation

of 1532′ B., and on the northwest side of the river at the big bend, 0.7 mile north of Kitzmiller, it makes a great cliff, 50 feet thick, coming a few feet above drainage, and it is visible in the river just beneath the highway bridge that connects Blaine and Kitzmiller. At Potomac Manor there is 15 feet of it exposed above drainage on the north side of the river and at the mouth of Abram Creek its top is visible.

No quarries were observed at this horizon in either of the two counties, but as the ledge is well exposed at many convenient points and is nearly always massive and durable it would furnish an unlimited amount of good building stone.

The East Lynn Sandstone is of special scientific interest in the two counties due to the fact that vertebrate reptile tracks have been found on its surface on the northern side of North Branch of Potomac River, in Garrett County, Maryland, 0.4 mile south of Bloomington and about the same distance northeast of Hampshire, Mineral County. At this point there is 5 to 10 feet of the rock exposed above drainage and on its small area of visible surface there are exposed about thirty well-defined amphibian tracks, together with an impression that may represent the imprint of a stubby tail and another that would appear to have been made by the heavy hind part of the body squatting in the sand. These have been examined by Dr. R. S. Lull of Yale University who has stated that they represent a distinctly new species and who has given them the name of **Dyscritichnus piedmontensis.** Dr. Lull's description of these tracks, together with a brief history of their discovery and with several photographs made under his direction, is published in Chapter XXI.

In view of the presence of these tracks at Bloomington it is much to be regretted that the writer did not learn of their occurrence earlier in the field season so that other exposures of the East Lynn and adjacent sandstones of the Allegheny Series could have been searched for further recurrences of the same phenomenon, but many outcrops are described in detail above and the outcrop of the Lower Kittanning Coal, which just underlies this ledge, is shown on Maps II and IV so that further examination of the stratum by those interested is made comparatively easy.

LOWER KITTANNING COAL.

The **Lower Kittanning Coal,** coming just under the East Lynn Sandstone and 120 to 175 feet below the Upper Freeport Coal, is a soft, double-bedded seam, with a streak of slate near the middle, the total thickness varying from 2 to 3 feet, but also being much less in many localities. As shown on Maps II and IV it has several extensive outcrops along North

Branch of Potomac River between Piedmont and Wallman and also has an unbroken outcrop along the northwestern side of the escarpment of the Allegheny Front in both counties. It has been mined commercially at several points on the Maryland side of North Branch but in Mineral and Grant Counties has been used only for local fuel. Its outcrop is delineated on Maps II and IV and in Chapter XVII detailed sections, chemical analyses, and estimates of tonnage will be presented, under the subject of "Commercial Coal."

The Lower Kittanning Coal in the two counties has previously been known and mined as the "Clarion Coal," due to the early belief that the "Split-six" was the Lower Kittanning instead of the Upper Freeport, as it proves to be, the reasons for which have been already given.

LOWER KITTANNING FIRE CLAY.

The **Lower Kittanning Fire Clay**, coming just below the Lower Kittanning Coal and being 5 to 10 feet in thickness, is at times a fairly pure flint clay in the two counties but is usually sandy and impure. At Coal Prospect No. 371 on Map II, in Allegany County, Maryland, 0.5 mile northeast of Piedmont, there is flinty clay just under the Lower Kittanning Coal, its full thickness not being exposed. On the south side of North Branch, just opposite Luke, there is 5 feet of fire clay, lying between the East Lynn Sandstone and the Vanport Limestone, at an elevation of 1065′ B., and on the head of Howell Run, 2 miles southeast of Nethken, Mineral County, there is flint clay in association with the Vanport Limestone along the public road, at an elevation of 2495′ B. In Grant County it is recorded as 4′ 7½″ thick in the Davis Coal and Coke Company No. 73 Coal Test Boring (No. 74 on Map IV), the same being published as the Henry Section, page 186. In view of the scanty exposures noted it is not believed that this clay offers much hope for commercial exploitation.

VANPORT LIMESTONE.

The **Vanport (Ferriferous) Limestone,** belonging just under the Lower Kittanning Fire Clay and a few feet below the Lower Kittanning Coal, and being a marine zone in portions of western Pennsylvania and eastern Ohio, is present in the two counties but is apparently non-marine in character, as a persistent search revealed no fossils. On the north side of North Branch between Westernport and Luke, Maryland, there is a ferriferous limestone bedded in the extreme top of the Homewood Sandstone that appears to represent the Van-

port and on the south side of North Branch, opposite Luke, there is 25 feet of sandy shale with ferriferous nodules at the Vanport horizon. On the east side of North Branch, 0.5 mile northeast of Chaffee, there is one foot of ferriferous limestone, coming 3 feet below the Lower Kittanning Coal and 5 feet above the railway grade, and there are other exposures of the bed southwestward toward Chaffee. On the head of Howell Run, 2 miles southeast of Nethken, it is visible in the public road at an elevation of 2495′ B.

KITTANNING SANDSTONE.

The **Kittanning Sandstone,** belonging between the Vanport Limestone and Clarion Coal, is apparently absent from the measures at most points in the two counties, but in the Bond Section, page 161, it is recorded as 17 feet thick and massive, coming 13 feet below the Lower Kittanning Coal and 50 feet above the Homewood Sandstone, as exposed at the old Everette Tunnel (now an open cut) northwest of Bloomington, Maryland.

CLARION COAL.

The **Clarion Coal,** coming just below the Kittanning Sandstone and a few feet above the top of the Homewood, is apparently absent from the measures at most points in the two counties, having been noted only at **Exposure No. 390 on Map IV** in Grant County on the east side of North Branch, opposite Wallman, Maryland, at an elevation of 2235′ B., coming 10 feet below the Lower Kittanning Coal and 5 feet above the top of the Homewood Sandstone. From an economic standpoint it would have no value. As previously stated, the coal which has been mined at several points along the Maryland side of the North Branch under the name of Clarion appears to be the Lower Kittanning seam.

ECONOMIC ASPECTS, ALLEGHENY SERIES.

From an economic standpoint the Allegheny Series is of interest principally because of the presence of three commercial coals, the value of which has been fully recognized. Its fire clays, which in some other counties are thick and pure, offer little hope of commercial exploitation for refractory purposes in the two counties, as they are usually sandy and impure, the deposits, in the few cases where the clay is of better grade, being apparently of limited extent. Some of these clays, however, would furnish material for building, or possibly paving brick, and are worthy of some attention for

that reason. Most of the sandstones are of a massive and durable character and are capable of furnishing vast quantities of building stone, there being numerous localities where they could be quarried to advantage along North Branch of Potomac where trunk-line transportation is afforded, but they are of a dull gray color that is not well adapted for the ornamental effects usually desired in architecture where more coloring or relief of texture is wanted. The series has no limestones of value for any known industrial purpose, as they are all thin and impure. Its disintegrated shales make poor agricultural soil, as they are deficient in lime and other ingredients favorable to plant growth and usually require much fertilization to produce only fair crops, while the great percentage of sandstone renders much of the land entirely barren.

CHAPTER IX.

STRATIGRAPHY---POTTSVILLE SERIES.

GENERAL ACCOUNT AND SECTION, POTTSVILLE SERIES.

The Pottsville Series of the Pennsylvanian Period, coming just under the Allegheny and lying just over the Mauch Chunk Series, or red shales, of the Mississippian, is present in Mineral and Grant Counties but as a rule is poorly exposed. It has an apparent thickness of 350 to 450 feet, this being slightly greater than usually found in western Pennsylvania and only about one-tenth of that recorded at its maximum development in southern West Virginia. In the latter region it has been subdivided by Dr. I. C. White into the Upper Pottsville, or Kanawha Group, the Middle Pottsville, or New River Group, and the Lower Pottsville, or Pocahontas Group, and of these subdivisions custom has sanctioned the use of the geographic titles. In Mineral and Grant Counties there is found about 315 feet of the Kanawha Group and only about 70 feet of the New River, while the Pocahontas has already disappeared many miles farther southwest. In the two counties the series is composed of heavy and often conglomeratic sandstone members with interbedded sandy shales, fire clays, and impure and lenticular coals, limestone being almost entirely absent. At all points observed the coals are too thin or impure for commercial mining and would furnish only a very limited amount for local use. Conglomerates seem to occur mostly in the upper half, although the Sharon Sandstone at the base is pebbly in most other regions. Fire clays, also, are confined to the upper portion. The following general section, compiled from all available data, shows the nature of the series in the two counties:

General Section of the Pottsville Series for Mineral and Grant Counties.

	Thickness. Feet.	Total. Feet.
Sandstone, Homewood, massive, gray, pebbly, prominent at the mouth of Georges Creek, at the highway bridge east of Luke, at Schell, etc., 50′ to	80	80
Coal, Tionesta, impure and lenticular, 1′ to	2	82
Fire clay, Mount Savage, flinty or plastic, mined at Piedmont, but lenticular or impure at most other outcrops, 5′ to	13	95
Coal, Upper Mercer (Stockton "A" ?), impure and lenticular, 1′ to	2	97
Shale, sandy, horizon of **Kanawha Black Flint** of southern West Virginia and **Mercer Limestone** of western Pennsylvania	14	111
Coal, Lower Mercer (Stockton), lenticular, 0′ to	1	112
Shale, sandy	8	120
Sandstone, Upper Connoquenessing, massive, gray, pebbly, usually makes great cliff, 75′ to	140	260
Shale, Quakertown, black, fissile, contains brackish-water fossils	8	268
Coal, Quakertown, (Winifrede?), impure, 1′ to	2	270
Shale, sandy	5	275
Sandstone, Lower Connoquenessing, (probably same as **Lower Gilbert** of southern West Virginia), massive, 40′ to	20	295
Shale, sandy, not fully exposed, 30′ to	20	315
Sandstone, Nuttall, massive, gray, coarse, 15′ to	10	325
Shale, sandy, not fully exposed, 15′ to	5	330
Sandstone, Guyandot, massive, gray, coarse	10	340
Shale, Hartridge, black, fissile, ferruginous, contains brackish-water fauna in more western counties, 20′ to	9	349
Coal, Sewell (Sharon?), soft, too thin for mining	1	350
Shale, sandy	4	354
Sandstone, Sharon (Upper Raleigh?), coarse, massive, 15′ to	30	384
Coal, Fire Creek, lenticular, 0′ to	1	385
Shale, red and variegated, top of Mauch Chunk Series	....	.....

A study of the above section shows that from a lithologic standpoint it is composed, approximately, of 75.32 per cent. of sandstone, 22.34 per cent. of sandy shale or fire clay, and 2.34 per cent. of coal.

Owing to the great amount of thinning northeastward across the State, the problem of proper correlations in the series is much complicated. A study of the section presented above reveals the fact that the Homewood Sandstone, Tionesta Coal, Mount Savage Fire Clay, Upper Mercer Coal, Mercer Limestone, Lower Mercer Coal, Upper Connoquenessing Sandstone, Quakertown Coal, Lower Connoquenessing Sandstone, Sharon Coal, and Sharon Sandstone are western Pennsylvania titles, while the remainder are from the nomen-

clature of central and southern West Virginia. The series has now been examined all the way across West Virginia so that conclusions on the identity of certain strata may be made. The Homewood Sandstone has apparently been traced all the way to the Kentucky State Line. The Tionesta Coal has been recognized for only a comparatively short distance southwestward in the State. The Upper Mercer Coal has been followed almost continuously to the waters of the Great Kanawha River where it appears to correlate with the Stockton "A" Coal of that region. The Kanawha Black Flint is best developed in the Great Kanawha Valley but has been traced by its fauna recurring in shale as far northeast as southern Upshur County and from this region northeastward its position has been postulated from its known relationship to other strata, making it appear to be the same as the fossiliferous Mercer Limestone of western Pennsylvania. It is quite significant that flint is reported at this horizon in the bore hole at Henry, Grant County, published as the Henry Section, page 187, although for many miles from Henry southwestward to northern Nicholas County no true flint occurs.

The Lower Mercer Coal appears, without much doubt, to be at the same stratigraphic horizon as the Stockton Coal of the Great Kanawha Valley. The Upper Connoquenessing Sandstone is a massive conglomerate that is easily traced as far southwestward as southern Upshur County where it suddenly loses its pebbly character and apparently breaks up into less conspicuous beds of which the Upper Coalburg Sandstone of the Great Kanawha region may be a part. The Quakertown Shale is typical of the Tygart Valley. River region of Barbour and Randolph Counties and has been easily traced northeastward to the Potomac, but southwestward has not been successfully followed, although the Coalburg Shale which contains **Orbiculoidea capuliformis** in northern Nicholas County may be its southern representative. The Quakertown Coal, for reasons advanced in the Tucker and other County Reports of the writer, can not be far from, and may quite well be, in fact, the same as the Winifrede Coal of Kanawha County. The Lower Gilbert Sandstone, which has been traced without much doubt as a massive bed from Mingo County northeastward to Webster County, and thence with less accuracy by its frequent recurrence in association with other known strata, would appear to be at much the same horizon as the Lower Connoquenessing of Pennsylvania.

The Nuttall Sandstone, with which the New River Group begins, has been followed with fair accuracy from the New River region northeastward into Randolph County and

thence, by its relationship to the Lower Gilbert Sandstone and by its uniformly decreasing interval from the Hartridge Shale and Sewell Coal, into Tucker County and the Potomac region where it seems to have no equivalent among members described and named in early reports. The Guyandot Sandstone of southern West Virginia appears to follow the outcrop of the Sewell Coal across the State, although the ledge just over the coal in Mineral County may represent the Lower Guyandot or a combination of the two. The Hartridge Shale, typical of Randolph County, has been traced by its fauna and lithologic association as far southwest as Fayette County and as far northeast as Tucker County. This shale is present in Mineral County, there being no fossils observed in it, but in Maryland it is described by Dr. Swartz as fossiliferous, being called the Sharon Shale. The Sewell Coal of southern West Virginia appears without reasonable doubt to be the same as the Sharon Coal of Pennsylvania, its correlation on the basis of fossil plants having long ago been suggested by Dr. David White, formerly Chief Geologist of the United States Geological Survey, and its actual tracing by outcrop having now been completed by members of the West Virginia Survey. The Sharon Sandstone, lying just under the Sharon Coal in northern West Virginia and western Pennsylvania, has been traced southwestward across the State by its almost universally conglomeratic character until it is found to correspond to the Upper Raleigh of New River, although a few new beds gradually wedge in between it and the Sewell (Sharon?) Coal. The Fire Creek Coal has been traced directly from New River to southern Webster County and thence northeastward recurs with a similar bed section and in the same stratigraphic association, with the decreasing interval that is to be expected, in western Randolph County and southern Tucker, and a remnant of it is finally found on Slaughterhouse Run along the Potomac just below Piedmont, Mineral County.

The above review of continuous Pottsville beds across the State, studied in conjunction with sections in southern West Virginia, indicates that northeastward thinning in the Kanawha Group has occurred mainly between the Upper Connoquenessing (Upper Coalburg) and Lower Connoquenessing (Lower Gilbert) Sandstones, but also the measures below the latter have disappeared completely. In the New River Group there has been a gradual disappearance, or shrinkage, of beds at several stratigraphic levels without the loss of any large group of members at a particular stage. In sharp contrast to the stratigraphic tenacity of these two groups is the behavior of the Pocahontas Group which thins

out completely in the central portion of the State near the longitude of Nicholas County.

TOPOGRAPHIC EXPRESSION, POTTSVILLE SERIES.

The topography of the Pottsville in the two counties is usually rough. Its outcrop is confined to such comparatively narrow belts, however, that its rocks are seldom seen entirely free from the influence of other sediments lying above or below it and for that reason no distinctive forms are developed. Along the North Branch of Potomac, where its upper portion is frequently exposed, there are huge cliffs which make bold shoulders along the valley and from which much talus accumulates on the slopes and in the river bed below them, the region in the vicinity of Schell and the mouth of Stony River being quite typical. Along the great mountain scarp of the Allegheny Front, composed almost entirely of the Pottsville, the slopes on the west where the strata dip toward the Stony River and North Potomac Basins have a gentle appearance when viewed at a distance but on close inspection prove to be invariably rough in detail, due to accumulations of debris rather than to differential erosion. On the eastern rim of this mountain the Pottsville cliffs are sheared off abruptly by the deep erosion of New Creek and other longitudinal valleys. In general the series produces an extremely poor soil, unfit for cultivation and usually worthless for grazing so that the land has seldom been cleared.

AREAL EXTENT, POTTSVILLE SERIES.

In Mineral County, as shown by Map II, the Pottsville Series is fully exposed at Piedmont and immediately eastward where the North Branch of Potomac River cuts a great gap through the mountains, and southwestward in the same valley its top is exposed at several localities, the most extensive being in the vicinity of Schell where the nose of the Blackwater Anticline protrudes northward. Along the Allegheny Front it is exposed for many miles, but owing to the great amount of debris and vegetation, as well as to rapid dip of the strata, it can not be easily studied.

In Grant County, as shown by Map IV, it is exposed along the North Branch of Potomac from the mouth of Stony River southwestward for a few miles and on the latter stream for a short distance up from its mouth, and it outcrops along the escarpments of Cabin Mountain and the Allegheny Front, the dip along the former being southeastward and along the latter northwestward. These long mountain exposures are easily accessible at only a few points, and even if laboriously

followed throughout their extent, afford little opportunity for detailed observation.

By far the best idea of the Pottsville stratigraphy of the two counties may be gained in Garrett County, Maryland, along the Baltimore and Ohio Railroad grade in the vicinity of Bond Station, four or five miles west of Piedmont. This latter exposure was utilized to a large extent in making up the general section of the series for the two counties.

CONTACTS, POTTSVILLE SERIES.

The contact of the Pottsville Series with the Allegheny lying above it has already been discussed in Chapter VIII. At the base of the series, where it lies upon the Mauch Chunk Red Shales, there is a wide-spread and striking unconformity. Here the coarse, gray, and massive rocks of the Pottsville, with their attendant coal beds and bituminous shales, rest upon red shales with included thin strata of fine-grained, micaceous, and flaggy sandstones, there being an almost total absence of coal. The inference drawn by many observers is that the sediments forming the Mauch Chunk Series may have been exposed to oxidizing agents for a long period prior to deposition and that they were deposited in comparatively shallow water which receded and left them bare and subject to erosion for another long time before Pottsville deposition began.

FOSSIL LIFE, POTTSVILLE SERIES.

No invertebrate remains were found in the Pottsville of either county, but on the northern side of the Potomac in Allegany County, Maryland, 0.7 mile east of Piedmont, a sparse fauna of brackish-water affinities was found in the Quakertown Black Shale, the only species collected being identified by Dr. John L. Tilton as **Naiadites elongata** (see Chapter XXI). On the Maryland side of the Potomac, also, Dr. C. K. Swartz of the Maryland Survey has recorded a fauna of somewhat similar characteristics in the Hartridge (Sharon) Shale. Both the Quakertown and Hartridge Shales were recognized at various points in Mineral and Grant Counties but no fossils, other than plants, were observed.

In the Pottsville of southwestern West Virginia there are several well-defined faunal zones but most, if not all, of these thin out and disappear in coming northeastward across the State toward the region of minimum thickness in the Pottsville, both the Quakertown and Hartridge Shales being typical of central and northern, rather than southern and

southwestern, West Virginia. It has already been noted, however, that fossils occur at the Mercer Limestone stage in western Pennsylvania and they are also recorded by Dr. Swartz as found in the same beds in Maryland. Inasmuch as the Mercer Limestone is at near, if not actually the same, stratigraphic level as the Kanawha Black Flint horizon of southern West Virginia, it would seem that fossils at this level should be found in Mineral, Grant, Tucker, and Randolph Counties, but a persistent search by the writer in all these counties has not yet revealed them.

The Pottsville Series of the two counties is rich in plant remains but no study of these has been made for this Report.

DESCRIPTION OF MEMBERS, POTTSVILLE SERIES.

HOMEWOOD SANDSTONE.

The **Homewood Sandstone,** coming at the top of the Pottsville, is a massive, gray, pebbly stratum, varying in thickness from 50 to 100 feet, being often much cross-bedded but invariably hard and durable. In Chapter V it is recorded in the Piedmont Section as 75 feet thick, in the Luke Section as 40 to 50 feet thick, in the Westernport Section as 76 feet thick, its horizon being partly composed of sandy shale, in the Bond Section as 62 feet thick but split into three separate ledges by shale, fire clay or coal, in the Gleason Section as being only partly exposed above the river, in the Hubbard Section as 95 feet thick but partly concealed, and in the Schell Section as 80 feet thick and a massive, pebbly cliff. At Piedmont this ledge is prominent between the Baltimore and Ohio Railroad and the street leading toward Keyser in the eastern part of town, and farther east is well exposed over the fire clay mine of the Potomac Fire Brick Company. At Westernport it makes a massive cliff just above the Western Maryland Railway grade just west of the mouth of Georges Creek, and east of this creek forms a great shoulder upon which part of the town is built. At Luke it makes a large cliff on the West Virginia side of the Potomac opposite the paper-mill. Farther up North Branch of the Potomac it rises from the river at Gleason and makes almost continuous cliffs all the way up to a point one-half mile above Wallman, Maryland, the abutments of the Western Maryland Railway bridge across the river just below Wallman being built on its lower portion. The ledge is especially prominent at Schell and it also forms the beds of the Potomac and Stony Rivers at the mouth of the latter stream. Along the northwestern side of the Allegheny Front in both Mineral and Grant Coun-

ties, it is exposed at many points well up toward the top of the mountain.

So far as known the Homewood Sandstone has not been quarried in either county but at many points along the North Branch of Potomac it would furnish easily accessible and durable stone for rough masonry structures.

TIONESTA COAL.

The **Tionesta Coal**, coming just below the Homewood Sandstone, is an impure and very lenticular bed, its thickness usually varying from 1 to 2 feet but sometimes being greater than the latter figure. On account of its included slaty material and its frequent total disappearance, it appears probable that the seam can never be mined commercially and that it will furnish only a very small amount of local fuel. In Allegany County, Maryland, it is visible at **Exposure No. 391 on Map II**, on the north side of North Branch of Potomac, one-third mile east of Piedmont, at an elevation of 955′ B., and having a thickness of 1′ 6″, as recorded in the Westernport Section, page 154. The following exposure of the Tionesta and its associated Mercer Coals was noted as the eastern edge of Piedmont, Mineral County:

Baltimore and Ohio Railroad Exposure—No. 392 on Map II.

On the south side of North Branch of Potomac River, 500 feet east of the Piedmont Grocery; **Tionesta Coal**; elevation, 940′ B.

	Ft.	In.
Fire clay		
Coal, slaty, **Tionesta** (940′ B.)	1	0
Shale, dark	3	0
Sandstone	4	0
Shale, gray, sandy	5	0
Coal 0′ 3″ Slate, dark 0 2 **Coal** 2 0 — **Upper Mercer** (Exposure No. 400 on Map II)	2	5
Fire clay shale, dark	3	0
Sandstone, shaly	10	0
Shale, dark, plant fossils, **Kanawha Black Flint** horizon	1	0
Coal, soft 0′ 8″ **Coal**, hard 0 3 — **Lower Mercer** (Exposure No. 401 on Map II)	0	11
Fire clay shale	5	0
Sandstone, shaly	15	0
Shale, sandy, and concealed	15	0
Sandstone, massive, **Upper Connoquenessing**, visible	15	0

The following exposure shows a fair thickness of clean coal but is only a lens, as may be seen by tracing its outcrop in either direction along the railroad track:

Photo by E. E. HARRIS.

PLATE XIII.—Outcrop of Hamilton Shale on Northwestern Pike just west of Burlington, showing characteristic features. This locality is profusely fossiliferous.

Baltimore and Ohio Railroad Exposure—No. 393 on Map II.

On the south side of North Branch of Potomac River, opposite Luke; **Tionesta Coal**; elevation, 950′ B.

	Ft.	In.
Sandstone, massive, with shaly streaks, **Homewood**	75	0
Coal	2	7
Slate, dark, coaly	1	6
Fire clay, **Mount Savage**, to grade	5	0

In Garrett County Maryland, it is visible at the **Baltimore and Ohio Railroad Exposure (No. 394 on Map II)**, on the south side of Savage River, 0.9 mile southeast of Bond Station, at an elevation of 1380′ B., and having a thickness of 2′ 2″, with an included slate parting of 2 inches, as recorded in the Bond Section, page 161. The following exposure was noted along the Potomac in Mineral County:

Western Maryland Railway Exposure—No. 395 on Map II.

On the east side of North Branch of Potomac River, 1 mile north of Warnocks; **Tionesta Coal**; elevation, 1055′ B.

	Ft.	In.
Sandstone, massive, pebbly, **Homewood**	15	0
Coal	0	6
Fire clay shale, to grade	10	0
Sandstone, massive, to river	15	0

The following exposure was noted in a new highway cut well up toward the top of the Allegheny Front in Mineral County and appears to represent the Tionesta horizon. The thickness, however, is excessive, probably due to local outcrop squeezing. Owing to its much weathered condition a fair chemical sample could not be procured:

Coal Exposure—No. 396 on Map II.

On the head of Emory Run, 1.3 miles northeast of Hartmansville; **Tionesta Coal**; elevation, 2715′ B.

			Ft.	In.
Sandstone, massive, **Homewood**			----	----
Coal, slaty, weathered	4′	0″		
Slate, bony	2	6		
Shale, gray	1	6		
Coal	0	3	8	3
Slate, black			0	6
Fire clay, flint, with ferriferous limestone, **Mount Savage**			----	----

The two following sections were noted along the Potomac, both in Mineral County:

Western Maryland Railway Exposure—No. 397 on Map II.

On the east side of North Branch of Potomac River, 0.7 mile north of Schell; **Tionesta Coal**; elevation, 1975′ B.

	Ft.	In.
Sandstone, massive, pebbly, **Homewood**	60	0
Coal and slate, **Tionesta**	1	0
Sandstone, to grade	10	0

Western Maryland Railway Exposure—No. 398 on Map II.

On the east side of North Branch of Potomac River, 0.3 mile southeast of Schell; **Tionesta Coal**; elevation, 2030′ B.

		Ft.	In.
Sandstone, massive ..... 25′ 0″ Concealed and coal blossom ..... 15 0 Sandstone, massive 10 0	**Homewood**	50	0
Coal, very slaty, **Tionesta**		3	3
Fire clay shale and concealed, to grade		5	0

The Homewood Sandstone at the above exposure is split by a parting of shale and coal, as is frequently the case along the Potomac.

The Tionesta Coal is also noted in a bore hole at Henry, Grant County, being 1′ 2″ thick, as indicated in the Henry Section, page 187.

MOUNT SAVAGE FIRE CLAY.

The **Mount Savage Fire Clay**, coming just under the Tionesta Coal and only a few feet below the Homewood Sandstone, was noted at several points in the vicinity of Piedmont and elsewhere. It exhibits a varying section, being at some points composed almost entirely of flint clay which in other localities is replaced by plastic material, while at some exposures both flinty and plastic clay are present, the latter condition being more common. Pure clay of either type is also lacking entirely at various outcrops, the horizon being occupied by ferruginous or sandy shale. In thickness the bed varies from 5 to 15 feet.

This clay may best be studied in the vicinity of Piedmont where it has long been mined for brickmaking and other refractory purposes. The two following measurements were made at the mine of the Potomac Fire Brick Company which has extensive drift openings into the bed, one section being made at the mine mouth to show its relationship to the Homewood Sandstone and another in a working room where fresh clay was obtained:

Potomac Fire Brick Company Mine.

On the south side of North Branch of Potomac River, 0.7 mile southeast of Piedmont; **Mount Savage Fire Clay**; elevation, 1130′ B.

Section at Mine Mouth:

		Ft.	In.
1.	Sandstone, massive, cliff, **Homewood**	30	0
2.	Fire clay, partly concealed	20	0
3.	Iron ore	1	0
4.	Fire clay	10	0
5.	Sandstone, massive	10	0

Section in Room:

1.	Fire clay, flint	6′	0″		
2.	**Coal**, lenticular, 1′ 0″ to	0	0		
3.	Fire clay, soft	3	0		
4.	**Coal**	0	6	9	6
5.	Shale, pavement				

A sample (No. 465R) was collected from Nos. 1 and 3 of the room section, the composition of which is reported as follows by Mr. Kaplan:

	Per cent.
Silica (SiO_2)	51.70
Ferric Iron (Fe_2O_3)	3.57
Alumina (Al_2O_3)	29.92
Lime (CaO)	0.32
Magnesia (MgO)	0.61
Potassium (K_2O)	1.00
Sodium (Na_2O)	0.48
Titantium (TiO_2)	1.06
Phosphoric Acid (P_2O_5)	0.08
Moisture	0.70
Water	10.36
Organic Matter	0.60
Total	100.40

Fusibility of clay in reducing atmosphere, +2750° F.

Mr. Kaplan comments on this analysis as follows:

"Hygroscopic water, labeled 'Moisture,' and essential water were determined separately. No attempt was made to determine the ferrous iron separately; all the iron was calculated and reported as ferric. 2750° F. is the highest temperature that can be determined by means of a fire clay furnace. The clay showed no signs of fusion at that temperature and there is reason to believe that its actual fusing point is considerably higher than 2750° F."

According to Mr. W. F. Caldwell, Manager of the plant and mine, the following section was measured in the main heading in the year 1916:

		Ft.	In.
1.	Top rock, sandstone, (Homewood)	....	....
2.	Slate	5	0
3.	Sandstone	1	6
4.	Soft clay, working bench	3	0
5.	Coal and bone	4	0
6.	Clay, coal, and bone in layers 6″ to 18″ thick	18	0
7.	Bottom rock, sandstone	....	....

No. 4 of the above section is reported to be much thicker in the present workings and would appear to correspond with Nos. 1 and 3 of the room section where the clay was sampled. Nos. 5 and 6 probably represent the Upper Mercer Coal. A description of the brick plant will be found in Chapter XX.

Farther east the Mount Savage Clay has been partly exposed along the Hoffa-Martin Coal Company incline, just east of Slaughterhouse Run and 1 mile southeast of Piedmont, at an elevation of 1345′ B., its full thickness not being visible. Along the Baltimore and Ohio Railroad grade a short distance west of the brick plant there is 15 feet of mixed clay and sandy shale but a little farther west, at Coal Exposure No. 392, its horizon between the Tionesta and Upper Mercer Coals is occupied by sandy shales and sandstone without any evidence of pure clay. On the north side of the Potomac, however, it has recently been prospected at several points along the steep, wooded hillside southeast of Westernport, nearly all of the openings showing a considerable thickness of good clay, there being 5 feet of flinty clay recorded as visible, and 11 feet reported as having been found, in the Westernport Section, page 154. At the mouth of Georges Creek there is 8 feet of flinty but impure clay recorded in the Luke Section, page 159, and along the Baltimore and Ohio Railroad grade just south of the highway bridge connecting Luke and Piedmont, there is approximately 5 feet of flinty clay, as noted in the section for the latter town, page 157. It is also visible along the B. & O. grade one mile southeast of Bond Station, Garrett County, Maryland, there being 10 feet of plastic clay recorded at its horizon in the Bond Section, page 161.

Aside from the exposures enumerated above in the general neighborhood of Piedmont, the Mount Savage Clay was observed only at Coal Exposure No. 396 (see page 257, on the head of Emory Run, 1.3 miles northeast of Hartmansville, Mineral County, but it is recorded in the Henry Section, page 187, as being 23 feet thick and occupying about the entire interval between the Tionesta and Upper Mercer Coals, being 597 feet below drainage at that point.

UPPER MERCER COAL.

The **Upper Mercer Coal,** coming almost immediately under the Mount Savage Fire Clay and from 15 to 25 feet below the Homewood Sandstone, is an impure and lenticular bed, varying from 1 to 2 feet in thickness at most points where it was observed. It appears to be too thin and uncertain for commercial mining and of little apparent value even for local fuel. At **Coal Prospect No. 399 on Map II,** located in Allegany County, Maryland, on the north side of North Branch of Potomac River, 0.4 mile east of Piedmont, and having an elevation of 975′ B., there is 2′ 2″ of soft coal, as recorded in the Westernport Section, page 154. At the **Baltimore and Ohio Railroad Exposure (No. 400 on Map II),** located 0.3 mile southeast of Piedmont there is a total showing of 2′ 5″ at the Upper Mercer horizon, with a slate parting in the upper portion, as recorded in conjunction with Exposure No. 392 in a measurement showing the three coals of the Mercer Group. Elsewhere in the two counties it was not observed at outcrop, but it is recorded in a bore hole at Henry, Grant County, as being 1′ 3″ thick and slaty, as noted in the Henry Section, page 187.

It appears reasonably certain that the Upper Mercer Coal is the same as the Stockton "A" Coal of the Great Kanawha Valley, as it has been traced almost continuously from northern West Virginia southwestward to the region where the latter title has been applied to the seam.

KANAWHA BLACK FLINT.

The **Kanawha Black Flint,** which appears beyond much question to belong in the interval between the Upper and Lower Mercer Coals, has been traced by its marine fauna and associated stratigraphy from its type locality in the Great Kanawha Valley northeastward to central West Virginia where its relationship to the Mercer Coal Group is not subject to much doubt. In Mineral and Grant Counties its horizon is occupied by black shale apparently without a marine fauna, as is the case in Tucker and Randolph Counties, but through all these northern counties the Mercer Coal Group has been traced to the region where the flint horizon becomes fossiliferous. In Mineral County its position is noted in the short section illustrating the occurrence of the Mercer Coals near Piedmont (see Exposures Nos. 392, etc., page 256) and in Grant County it is recorded in the Henry Section, page 187, where flint is reported at its proper horizon in the core test included in the section. The re-

corded presence of flint at this horigon in the northern part of the State is most interesting, as the cherty structure of the Kanawha Black Flint has not been observed at outcrop farther northeast than northern Nicholas County. It has long been claimed by Dr. I. C. White that the Kanawha Black Flint is at the same stage as the fossiliferous Mercer Limestone of western Pennsylvania, and from the accumulated evidence secured in tracing the flint horizon northeastward across West Virginia this early correlation would appear to be entirely correct.

LOWER MERCER (STOCKTON) COAL.

The **Lower Mercer Coal** of western Pennsylvania, (which from its relationship to the Kanawha Black Flint in central West Virginia is now determined beyond reasonable doubt to be the same as the Stockton Coal of the Great Kanawha Valley), is present in Mineral and Grant but is lenticular and impure and without apparent value either as commercial, or local, fuel, being hardly more than one foot thick. In Mineral County it is noted as 0′ 11″ thick at the **Baltimore and Ohio Railroad Exposure No. 401 on Map II,** located just east of Piedmont, as recorded in the short section published under Coal Exposure No. 392, page 256. In Grant County it is also noted in a bore hole at Henry, 1′ 2½″ thick, as detailed in the Henry Section, page 187.

UPPER CONNOQUENESSING SANDSTONE.

The **Upper Connoquenessing Sandstone,** coming a few feet under the Lower Mercer (Stockton) Coal and 100 to 140 feet below the top of the Pottsville Series, is a massive, gray, pebbly stratum, varying from 75 to 140 feet in thickness and usually making bold cliffs wherever it appears above drainage. Along the North Branch of Potomac it is recorded in the Westernport Section as 30 to 50 feet thick and a massive cliff. In the Bond Section it is recorded as composed of two benches with a total thickness of 165 feet, of which the lower bench is quite pebbly. Just east of Piedmont there is 15 feet of its top exposed along the Baltimore and Ohio Railroad grade, as exhibited under Coal Exposure No. 392, page 256. In the Hubbard Section there is 55 feet of it recorded as visible above the river and 0.2 mile southwest of Hubbard there is 100 feet of it exposed above drainage, making a massive cliff. This ledge is also apparently the main factor in preserving from erosion the great escarpment of the Allegheny Front in both Mineral and Grant Coun-

ties. At the "Pinnacle" in the former county there is 30 to 40 feet of it visible and doubtless much more concealed by debris, its character being quite pebbly, and at the point where the Blaine-Elk Garden-Sulphur City highway intersects the Northwestern Pike its pebbly boulders are much in evidence. In Grant County the same pebbly cliff is present along the escarpment of the mountain southeast of the Stony River Dam.

So far as known the Upper Connoquenessing has not been quarried in either county. It is generally quite hard and durable but would probably be troublesome to work on account of its cross-bedded and quartzitic nature.

For reasons given under the discussion of the General Section of the Pottsville, page 251, it would appear that the Upper Connoquenessing is in part represented by the Upper Coalburg Sandstone of the Great Kanawha Valley.

QUAKERTOWN BLACK SHALE.

The **Quakertown Black Shale,** typical of the Tygart Valley River region of Randolph and Barbour Counties, and coming between the Upper Connoquenessing Sandstone and the Quakertown Coal, is present in Mineral and Grant but is well exposed at only a few points. This shale is black and fissile, with a thickness of 5 to 10 feet, and often contains brackish-water fossils. On the north side of North Branch, in Allegany County, Maryland, 0.7 mile east of Piedmont it is exposed along a public road, being 5½ feet thick, as recorded in the Westernport Section, page 154. From a collection made by the writer at this point, Dr. Tilton reports **Naiadites elongata,** as recorded in his fossil notes in Chapter XXI. In the Bond Section, page 161, there is 0′ 6″ of this shale recorded, and on the north side of North Branch, 0.2 mile southwest of Hubbard, there is 5 feet of it visible in the river edge. Along the Allegheny Front, where its horizon again outcrops, it was not distinguished, being usually covered by much debris from the cliff above it.

QUAKERTOWN (WINIFREDE?) COAL.

The **Quakertown Coal,** which, from evidence secured and reported in Tucker and other counties in central West Virginia, it would appear to correlate closely, if not absolutely, with the Winifrede Coal of the Great Kanawha Valley, is present at its proper horizon in Mineral County, being separated from the Upper Connoquenessing Sandstone by the Quakertown Black Shale and being 250 to 275 feet below the

top of the Pottsville Series. It varies from 1 to 2 feet in thickness at the few points where it is visible, and as it contains some impurities it can not be regarded as an economic asset of any present value. At **Exposure No. 402 on Map II,** located in Allegany County, Maryland, on the north side of North Branch of Potomac, 0.8 mile southeast of Piedmont, at an elevation of 925′ B., there is 1′ 5″ of coal, as recorded in the Westernport Section, page 154. On the Mineral County side of the same river, its blossom is visible along the Hoffa-Martin Coal Company incline east of Slaughterhouse Run and 1 mile southeast of Piedmont, at an elevation of 1235′ B. In Garrett County, Maryland, it is noted at **Baltimore and Ohio Railroad Company Exposure (No. 403 on Map II),** on the south side of Savage River, 0.5 mile east of Bond Station, at an elevation of 1420′ B., being 2′ 4″ thick with a parting of 0′ 9″, as recorded in the Bond Section, page 162. Exposure No. 402 is on the eastern rim of the North Potomac (Georges Creek) Basin and Exposure No. 403 is on the western side. Of the many borings made for coal along the North Potomac and Stony River Basins, it is not known that any have pierced the Quakertown horizon but in the vicinities of Steyer and Gorman the holes drilled for oil record no coal at the Quakertown horizon. Along the Allegheny Front in both Mineral and Grant Counties no Quakertown Coal was observed, but its outcrop in this region could well be concealed by debris.

LOWER CONNOQUENESSING SANDSTONE.

The **Lower Gilbert Sandstone,** with which a heavy stratum coming only 5 to 10 feet below the Quakertown Coal in the Mineral County region appears to correlate, is a widely persistent ledge, typical of Mingo County but extending from the Kentucky Line northeastward to Maryland, evidence of which has already been presented by the writer in the Tucker County Report of the Survey, pages 210-211. In the latter county there is an interval of 100 to 125 feet from the base of the Upper Connoquenessing down to the top of the Lower Gilbert but in Mineral County this has decreased to a bare 15 to 20 feet, as might be expected in the northeastward shrinkage of the Pottsville. As indicated in that report there is very good reason to believe that the Lower Gilbert is the same as the Lower Connoquenessing Sandstone of western Pennsylvania, since it is the first massive ledge below the Upper Connoquenessing and so continues into Tucker County where the interval has increased

between them as above stated. It is the belief of the writer that this ledge represents the same as that described erroneously as the "Upper Gilbert" in the Report on Barbour, Upshur, and the Western Portion of Randolph Counties, and if this be true the tentative idea expressed in that Report that the Lower Connoquenessing might correlate with one of the Winifrede Sandstones must be abandoned, as the rapid southwestward expansion of interval between the two Connoquenessings and consequent introduction of many new members between them had not then been imagined.

The **Lower Connoquenessing** or Lower Gilbert Sandstone of Mineral County is a gray, massive ledge, varying from 20 to 40 feet in thickness. As illustrated in the Bond Section, page 162, it is 40 feet thick, coming only 5 feet below the Quakertown Coal.

NUTTALL SANDSTONE.

The **Nuttall Sandstone,** as herein described is the second ledge which appears above the Sewell (Sharon?) Coal horizon along the Baltimore and Ohio Railroad grade about one-half mile east of Bond Station, Garrett County, Maryland, as indicated in the Bond Section, page 162. At this point it is a massive bed, 15 feet thick, having its top about 50 feet below the Lower Connoquenessing Sandstone and its base about 30 feet below the Sewell (Sharon?) Coal from which it is separated by another intervening ledge. Its correlation is based largely on evidence secured in Tucker County and published for that area, there being in that region only three sandstone beds between the Quakertown (Winifrede?) and Sewell (Sharon?) Coals, which is also true of the Pottsville exposure recorded in the Bond Section. In Tucker County these three ledges were classified as the Lower Gilbert (Lower Connoquenessing), Nuttall Sandstones (one bed representing the two Nuttalls of southern West Virginia), and the Guyandot and Lower Guyandot Sandstones (also one ledge representing the two Guyandots of southern West Virginia). The recurrence of these three sandstones between the two coals mentioned at a point 40 miles from their Tucker County exposure indicates a somewhat remarkable persistence of deposition, more especially since three coals and two fossiliferous zones which are found in the Quakertown-Sewell interval of Tucker County have completely disappeared in the northeastward thinning toward Savage River.

GUYANDOT SANDSTONE.

The **Guyandot Sandstone,** coming a few feet above the Sewell (Sharon?) Coal from which it is separated by the Hartridge Shale, is the apparent northern remnant of the Guyandot and Lower Guyandot Sandstones of southwestern West Virginia. It is not clear whether the northern phase represents the actual Guyandot or whether it is the Lower Guyandot, but it at least is the same sandy stage that follows the outcrop of the Sewell (Sharon?) Coal northeastward from its more expanded type locality, and the name Guyandot may therefore be applied with propriety. The most prominent outcrop is on the west side of Slaughterhouse Run of North Branch of Potomac, 0.7 mile southeast of Piedmont, where it makes a 50-foot ledge, coming 20 feet above the Sewell (Sharon?) Coal as detailed at Prospect No. 404 on a later page of this Chapter. It is visible again on the south side of Savage River along the Baltimore and Ohio Railroad grade a short distance east of Bond Station, Garrett County, Maryland, where it is 10 feet thick and massive, as indicated in the Bond Section, page 162.

HARTRIDGE BLACK SHALE.

The **Hartridge Black Shale,** typical of Randolph County where it comes just over the Sewell (Sharon?) Coal and contains **Naiadites elongata** in profusion, is present at its proper horizon in Mineral and Grant Counties, being black, fissile, and sometimes ferruginous. Fossils were not observed in either county but it is believed they should be present as they occur in the adjoining county of Tucker on the southwest and are also reported to the northeastward by members of the Maryland Survey where the name of Sharon Shale has been applied to the member. On the west side of Slaughterhouse Run of North Branch of Potomac, 0.7 mile southeast of Piedmont, this shale is 20 feet thick, as detailed under the description of Coal Prospect No. 404 on a following page of this Chapter. It is visible again at Coal Prospect No. 406 along the Northwestern Pike just east of the summit of the Allegheny Front, 1.5 miles northeast of Hartmansville, Mineral County, being 4 feet thick and containing fossil plants.

SEWELL (SHARON?) COAL.

The **Sewell (Sharon?) Coal,** coming just under the Hartridge Black Shale and only 20 to 40 feet above the base of

the Pottsville, may be observed at only a few points in Mineral and Grant Counties. At these exposures it is usually less than one foot in thickness, leading to the opinion that it is not a valuable economic asset anywhere in the region of its outcrop in the two counties. Little positive evidence is available concerning its thickness and character in the very considerable territory of both counties where its horizon is deeply buried, as no coal test borings are known to have reached enough depth to have tested it and only two churn drill holes are available. One of these, drilled at Steyer, Maryland, reports four feet of "fine quality" coal at 470-474 feet below the surface that would appear to represent the Sewell seam. The other, located one-half mile northwest of Gorman, Maryland, shows no coal of any kind in the Pottsville, although the record appears to have been well kept. The showing of coal reported at Steyer is encouraging, but on the other hand the absence of apparent minable coal at the Sewell horizon both along the extensive Allegheny Front in Mineral and Grant Counties and along the rim rocks of the Canaan Valley in Tucker County adjoining Grant on the west makes it seem probable that expensive prospecting for it in the North Potomac and Stony River Basins of the two counties would be inadvisable.

The correlation of the Sewell Coal of Fayette County, southern West Virginia, with the Sharon of western Pennsylvania does not appear to admit of much further doubt. Based on the evidence of fossil plants in the roof shales, and long before detailed stratigraphic studies had been made, Dr. David White, formerly Chief Geologist of the United States Geological Survey, expressed his belief that the Sewell and Sharon Coals were probably identical. Members of the West Virginia Survey have now traced the Sewell Coal from its type locality on New River northeastward across the State to the Pennsylvania and Maryland Lines where Preston, Tucker, Grant, and Mineral Counties adjoin these two States, and have found that it dovetails with a bed that has long been recognized as the Sharon, thus proving and confirming by another geologic method the early deduction of Dr. White. The following prospect illustrates the occurrence of this coal along the Potomac River adjoining the Maryland Line:

Coal Prospect—No. 404 on Map II.

On the west side of Slaughterhouse Run, 0.7 mile southeast of Piedmont; **Sewell (Sharon?) Coal**; elevation, 1030′ B.

	Ft.	In.
Sandstone, massive, **Guyandot**	50	0
Concealed and sandy shale, **Hartridge**	20	0
Coal, Sewell (Sharon?) (1030′ B.), visible	1	0
Fire clay shale	4	0
Sandstone, massive, **Sharon (Upper Raleigh?)**	15	0
Coal, lenticular, Fire Creek (1010′B.), (Exposure No. 408 on Map II), 0′ to	1	0
Shale, variegated, top of **Mauch Chunk Series**	....	....

At the **Baltimore and Ohio Railroad Exposure (No. 405 on Map II)**, on the south side of Savage River, 0.3 mile east of Bond Station, Garrett County, Maryland, there is 2 feet of coaly slate visible at the Sewell horizon, at an elevation of 1470′ B., as detailed in the Bond Section, page 162, this point being on the western side of the North Potomac Basin. The following prospect was found farther south on the eastern side of the basin, thicknesses being estimated on the steeply dipping strata of the Allegheny Front:

Coal Prospect—No. 406 on Map II.

Along the Northwestern Pike on east side of Allegheny Front, 1.5 miles east of Hartmansville; **Sewell (Sharon?) Coal**; elevation, 2700′ B.

	Ft.	In.
1. Shale, black, with a few plant fossils and streaks of iron carbonate, **Hartridge**	4	0
2. **Coal, Sewell**	0	7
3. **Fire clay shale**, with plant rootlets	3	0
4. Sandstone, massive, coarse, **Sharon (Upper Raleigh?)**	30	0
5. Shale, sandy, with some black slate and streaks of sandstone	50	0
6. Shale, red, top of **Mauch Chunk Series**	....	....

The blossom of the coal is again visible at **Exposure No. 407 on Map IV** on the eastern side of the Allegheny Front, at an elevation of 2940′ B., 1.5 miles east of Bismarck, Grant County. Another exposure of some interest has been uncovered in recent years in Davis District, Tucker County, along the Babcock Lumber and Boom Company Railroad just west of the summit of Cabin Mountain and 2 miles southwest of the Stony River Dam, at an elevation of 3680′ B. Only a small amount of coal is visible here but so far as known there is no other exposure of this coal along Cabin Mountain.

SHARON (UPPER RALEIGH?) SANDSTONE.

The **Sharon Sandstone** of the western Pennsylvania Pottsville, appearing to correlate beyond much doubt with the Upper Raleigh Sandstone of the New River, West Virginia, phase of these measures, may be observed at various points in Mineral and Grant Counties, being a coarse and massive member, 15 to 30 feet thick, coming a few feet below the Sewell (Sharon?) Coal. In the Westernport Section, page 154, it is noted as 30 feet thick, and on the West Virginia side of the Potomac at Coal Prospect No. 404 it is 15 feet. In the Bond Section, page 162, it is recorded as coarse, massive, 35 feet thick, and containing plant fossils, and at Coal Prospect No. 406, page 268, it is 30 feet thick and of much the same character. It also appears to be well represented in the pebbly beds that make the escarpment of Cabin Mountain along the Grant-Tucker County Line. From Tucker County, as detailed in previous Survey Reports, this bed has been traced southwestward to the type locality of the Upper Raleigh Sandstone of New River.

FIRE CREEK COAL.

The **Fire Creek Coal** of the New River region, which appears to have no counterpart in the nomenclature of western Pennsylvania Pottsville, has been traced from its type locality with an often recurring section and stratigraphic sequence northeastward to the waters of Red Creek, near Laneville, southern Tucker County, beyond which its existence as a bed of minable size appears to cease. In Mineral County, however, it was noted at **Exposure No. 408 on Map II,** on the east side of Slaughterhouse Run of North Branch, 0.7 mile southeast of Piedmont, being one foot or less in thickness, and coming just under the Sharon (Upper Raleigh?) Sandstone, as detailed in connection with Exposure No. 404 of the Sewell Coal, page 268. It was not observed elsewhere in either of the two counties and does not appear to have economic significance.

ECONOMIC ASPECTS, POTTSVILLE SERIES.

As an economic group the Pottsville of the two counties appears to be of little value. The only member of it that has been put to industrial use is the Mount Savage Fire Clay which has been mined for brick and other refractory material at Piedmont. Pure clay at this horizon, however, occurs only in lenses of limited outcrop and extent and no exten-

sive development may be anticipated. The sandstones of the Pottsville, while usually durable, are often much cross-bedded and quartzitic, making them troublesome to quarry, and their uniformly dull, gray texture affords no architectural tone. The Pottsville soil is invariably poor and of small value either for agriculture or grazing.

CHAPTER X.

STRATIGRAPHY--MISSISSIPPIAN ROCKS.

GENERAL STATEMENT.

The Mississippian sediments of Mineral and Grant Counties include the three following groups of widely diversified character, listed in descending order:

Mauch Chunk Series; largely red shales and flaggy sandstones, fresh-water and marine, 500 to 800 feet thick.

Greenbrier Series; almost entirely calcareous and marine, 100 to 300 feet thick.

Pocono Series; heavy sandstones and gray shales, apparently without marine fossils in this area, 200 to 600 feet thick.

The nomenclature as employed above will be recognized as of eastern derivation, Mauch Chunk and Pocono being geographic localities in Pennsylvania and Greenbrier being a southern West Virginia title. These names are, or should be, of general application to rocks of this age in the northern Appalachian region, since the study of these beds in Virginia was begun by W. B. Rogers nearly a century ago, numerical titles being used which were later supplanted by the more natural and expressive geographic names. The Mauch Chunk and Pocono, in consequence, refer definitely to localities in Pennsylvania where these titles were fixed by the First and Second Geological Surveys of that State, while the name, Greenbrier, representing the massive limestone between the Mauch Chunk and Pocono, is derived from the river of that name in southern West Virginia where this stage attains a great development, and thereby supplants the earlier, indefinite "Mountain" Limestone.

In the southern extension of the Mississippian rocks through Kentucky, Tennessee, and Alabama, however, the early nomenclature used above has been applied in only

a tentative way or else not at all, most correlations having been based on titles employed in the region directly west of the Cincinnati Anticline, embracing portions of west Kentucky, Indiana, Illinois, Missouri, and Iowa. In this latter region, where a total Mississippian thickness of 2,700 feet is reported in some instances, many detailed paleontologic studies have been made and the correlation of groups and minor subdivisions is well advanced.

In southern West Virginia the Mississippian sediments have a maximum thickness of nearly, if not quite, 5,000 feet, as recently measured by the writer, being probably a few hundred feet thicker than in the anthracite coal fields of eastern Pennsylvania, and therefore representing the maximum of these rocks in North America. The relationship of these maximum beds to the typical Mauch Chunk and Pocono of Pennsylvania is apparent from their well-defined lithology and position with reference to the Greenbrier Limestone, which is itself typical of this southern West Virginia region, but the age equivalents of all three groups as compared to the exposures of Missouri, Illinois, and adjoining western States are not yet apparent for lack of paleontologic data. In the season of 1922, however, a large collection of fossils from the Mississippian of southern West Virginia was made by the writer and when these have been identified by Dr. George H. Girty, of the United States Geological Survey, who also spent a few days in the field, it is expected that definite criteria will be afforded for the long-desired comparison of eastern and western Mississippian sediments.

In Mineral and Grant Counties, where the total thickness of the Mississippian ranges from 1,000 to 1,700 feet and is therefore of attenuated occurrence as compared to both eastern Pennsylvania and southern West Virginia, the Mauch Chunk has a meager marine fauna near the base, the Greenbrier is marine throughout, and the Pocono reveals no fossils, as is usually the case in the State. Coals are not found in either the Mauch Chunk or Pocono, although the former contains a few thin seams of non-commercial rank in southern West Virginia, and the latter has some impure anthracitic coal both in southern and eastern West Virginia.

MAUCH CHUNK SERIES.

GENERAL ACCOUNT AND SECTION, MAUCH CHUNK SERIES.

The Mauch Chunk Series, comprising the upper portion of the Mississippian Period, and typical of the anthracite

Photo by E. E. HARRIS.

PLATE XIV.—View from road between Falls and Maysville, looking northeast. Rolling topography in foreground is Hamilton. Low wooded hills in middle are Portage. Patterson Creek Mountain in extreme background is Lower Devonian and Upper Silurian.

region of eastern Pennsylvania, has the following general section in the two counties under study:

	Thickness. Feet.	Total. Feet.
Gray sandstones, shales, and coals, **Pottsville Series**	----	------
Shales, red, with streaks of green, and with several beds of green, micaceous, flaggy, and lenticular sandstones, 400′ to	700	700
Limestone, Hinton?, with marine fossils, possibly **"Little Lime"** of oil fields	5	705
Sandstone, Webster Springs, massive, 10′ to	20	725
Shale, red, with streaks of sandstone, 50′ to	75	800
Limestone, top of **Greenbrier Series**	----	------

As indicated above, the series consists of red, or sometimes greenish, shales, ordinarily laminated but often slickensided, together with occasional beds of fine-grained, flaggy, micaceous sandstones of lenticular occurrence. Limestone is almost totally absent except in the lower portion where a thin, marine bed is found. Coal appears to be totally absent, no occurrence being recorded north of Webster County.

The conglomeratic Princeton Sandstone, which is a persistent and easily recognizable member of the upper portion all the way from Mercer County northeastward to southern Tucker, adjoining Grant, has either disappeared or lost its characteristic pebbles, although there are some fairly heavy sandstones along the Allegheny Front west of Scherr, Grant County, one of which may represent it.

Being largely of a continental nature the sediments of the Mauch Chunk Series differ materially from those of the Pottsville above it. From the thorough oxidation of material it would appear that long intervals of exposure occurred, probably beginning in ancient Appalachia and continuing through the time of degradation and possibly involving much reworking of mud and at least intermittent aerial conditions while the present strata were being formed.

TOPOGRAPHIC EXPRESSION, MAUCH CHUNK SERIES.

The Mauch Chunk in the two counties occurs only along steep mountainsides between the Pottsville above and the Greenbrier and Pocono below and therefore affords no complete topographic display, such as would occur if it covered a wide area. As limited and held in place by the groups mentioned it makes a rather smooth, steep slope, fairly free from benches, but partly obscured by Pottsville debris.

AREAL EXTENT, MAUCH CHUNK SERIES.

Mauch Chunk rocks within the limits of the two counties outcrop only in the gap of North Branch of Potomac

River between Piedmont and Keyser, and along the eastern slope of the Allegheny Front, starting with the gap exposure mentioned and continuing southwestward through the length of both counties. East of this belt they do not occur again in either county but west of it they pass deeply under the North Potomac and Stony River Basins and come out again on the western slopes of Backbone and Cabin Mountains in Garrett County, Maryland, and Preston and Tucker Counties, West Virginia, where they may be studied again at no great distance from the Mineral and Grant County Lines.

CONTACTS, MAUCH CHUNK SERIES.

The contact of the Mauch Chunk Series with the Pottsville above it and the wide unconformity existing at this stratigraphic level have been discussed under the description of the latter series. At its base the abrupt physical change from oxidized red shales to the massive, marine Greenbrier Limestone would indicate another hiatus of some magnitude but paleontologic collections in counties farther southwest where both the Mauch Chunk and Greenbrier are abundantly fossiliferous do not indicate that such is the case. Perhaps the most noticeable faunal difference is the presence of many pelecypods in the Mauch Chunk while in the Greenbrier they are much less common, brachiopods being more abundant. Dr. George H. Girty (Tucker County Report, page 454) attributes this difference to the well-known affinity of brachiopods for calcareous formations and of pelecypods and gastropods for shaly sediments. It would appear from the evidence, therefore, that no long time interval elapsed between the Greenbrier and Mauch Chunk but that there was probably a somewhat sudden elevation of the sea-bottom at the close of Greenbrier time, together with an incursion of muddy sediments along the shore-line.

FOSSIL LIFE, MAUCH CHUNK SERIES.

In Mineral and Grant Counties, marine fossils occur in the Mauch Chunk, so far as observed, only in its basal portion, there being a five-foot stratum of limestone coming 60 feet above the top of the Greenbrier and containing an abundant fauna. Above this horizon the remainder of the series appears to be barren, indicating subaerial or lacustrine conditions. No trace of the fauna that occurs under the Princeton Sandstone in many central and southern counties was found. In passing southwestward across the State, however, new fossil zones appear in the expanding section of the Mauch Chunk

until there are twenty or twenty-five of these at its maximum southern development and at the same time calcareous members become abundant, both factors indicating a steadily increasing depth of deeper and less turbid water during the time of deposition.

Plant fossils in the Mauch Chunk of the two counties are not abundant, owing to the very complete oxidation that occurred during the time of deposition.

DESCRIPTION OF MEMBERS, MAUCH CHUNK SERIES.

Hinton? Limestone.

As indicated in the General Section, page 273, no attempt has been made to differentiate members in the upper 400 to 700 feet of the Mauch Chunk of Mineral and Grant Counties, as the sandy beds appear to be lenticular and without distinguishing characteristics and no fossil zones or coals were found. Toward the lower portion, however, a marine limestone was found, its exposure being along the Baltimore and Ohio Railroad grade on the south side of Savage River, Garrett County, Maryland, 0.3 mile west of Bond Station, as follows:

		Feet.
1.	Limestone, siliceous, with marine fossils, Hinton?, visible	5
2.	Sandstone, massive, Webster Springs	10
3.	Shale, red, to top of Greenbrier Limestone, estimated	50

Elsewhere in the territory this limestone was not observed, although its horizon outcrops all the way along the Allegheny Front in both Mineral and Grant Counties. In Tucker County, however, it was noted by the writer at three localities (see Tucker Report, page 229), fossils being noted at two of these and the lithologic sequence at the exposure on Red Run of Dry Fork River being almost identical with that recorded above. In Randolph County the Mauch Chunk beds have not been studied in detail but in the Webster Report (pages 225-226) it is noted again by the writer at several localities and as carrying marine fossils. In all these counties it has been provisionally correlated as the **Hinton Limestone** of Krebs,[1] under the belief that the lower portion of the Mauch Chunk thinned out northeastward, permitting the Hinton Limestone to approach the top of the Greenbrier in position. The writer has recently made fossil collections from

[1] C. E. Krebs, Raleigh and Western Portions of Mercer and Summers Counties, W. Va. Geol. Survey, pp. 75, 76, and 88; 1916.

the Hinton Limestone at its type locality, but in the other counties named, including the Savage River exposure, no collections have been made, and paleontologic verification of the supposed Hinton member in the northeastern counties is for the present lacking. After studying the Mauch Chunk somewhat minutely in Mercer, Monroe, and Summers Counties, and after observing its lower calcareous members in less detail in Greenbrier and Pocahontas Counties, the writer is now inclined to think that one of these lower, fossiliferous beds may be the one which persists into Webster, Tucker, and Garrett Counties and that the Hinton may disappear as a lithologic unit. Pending further study of this phase of the Mauch Chunk, however, it appears best to preserve the name of Hinton Limestone in this Report as indicating the continuity of a fossiliferous bed from Webster County to Savage River.

Webster Springs Sandstone.

The **Webster Springs Sandstone**, coming under the supposed Hinton Limestone, and being typical of Webster County, is apparently represented in the Potomac region, as its occurrence on Savage River in the short measurement published under the description of the Hinton Limestone, page 275, is noted. Here it is 10 feet thick and massive, coming 50 feet above the top of the Greenbrier Limestone. It should also outcrop along the eastern slope of the Allegheny Front.

ECONOMIC ASPECTS, MAUCH CHUNK SERIES.

The chief economic value of the Mauch Chunk Series is as a soil maker. The red shales disintegrate readily, resulting in a moderately rich clay of the same color, that is easily tillable, but owing to its outcrop along the steep Allegheny Front may not be cultivated with much success. It makes good grazing land, however, and is generally so used.

A good grade of building brick could be made from almost any of the red shale strata that are comparatively free from bedded sandstones. A sample (No. 549R) taken from a fifteen-foot bed of shale on the land of Sanford Hanlin, located along the road which crosses the Allegheny Front from Scherr toward Bismarck, Grant County, and on the eastern slope of this mountain, 2.3 miles northwest of the former village, at an elevation of 2,700′ B., shows the following analysis according to Kaplan:

	Per cent.
Silica (SiO_2)	55.06
Ferric Iron (Fe_2O_3)	9.13
Alumina (Al_2O_3)	23.81
Lime (CaO)	2.06
Magnesia (MgO)	2.08
Loss on ignition	7.80
Total	99.94

The amount of iron in the above sample indicates that the shale would burn to a rich red color in a brick-kiln. The only place along the entire Allegheny Front where the Mauch Chunk is located favorably with respect to transportation and other factors favorable to brickmaking, however, would be at the extreme northern end where North Branch of Potomac cuts through the mountain between Piedmont and Keyser and where it is probable that samples of shale would show analyses similar to that given above.

The sandstones of the Mauch Chunk are nearly all too shaly to make durable building stone and their use in general would prove inadvisable.

GREENBRIER SERIES.

GENERAL ACCOUNT, GREENBRIER SERIES.

The Greenbrier Series, or Greenbrier Limestone, comprising the middle portion of the Mississippian rocks, is represented in Mineral and Grant Counties by a belt of gray, massive limestone containing some included deposits of red shale, and varying in thickness from 100 to 300 feet. It is marine in character, fossils being found in different zones from bottom to top, although locally barren belts occur. This limestone is typical of southern West Virginia where it has a thickness of 1,000 to 1,100 feet as recently measured by the writer in Monroe County, representing almost, if not quite, its maximum development. From this region it gradually thins northeastward, being 430 feet thick at Laneville, Tucker County, just west of the southwestern corner of Grant County, and from thence decreasing northward and wedging out completely in southern Pennsylvania. In northern West Virginia no attempt has been made to subdivide it into definite paleontologic or lithologic zones and none would now be advisable, as the writer has recently completed a field study of its occurrence in Monroe and other southern counties, where definite subdivisions, based on combined lithologic and paleontologic peculiarities, have been made. By actual test many of these subdivisions were traced as far

northeast as Marlinton where nearly half the thickness has vanished, and it is believed that a final determination of those zones which persist entirely across the State may eventually be made.

TOPOGRAPHIC EXPRESSION, GREENBRIER SERIES.

In topographic expression the Greenbrier Series shows no complete forms, as its outcrop is confined to a narrow belt along the eastern slope of the Allegheny Front. At its level, however, there is invariably a considerable bench caused in part by the resistance of the hard and siliceous Pocono ledges just below and in part by the readily disintegrating Greenbrier itself and the easily eroded Mauch Chunk above it. Surface weathering is so far advanced along most of this outcrop that limestone may be seen at only a few points, recognition of its zone being dependent mainly on the bench mentioned and on its peculiar type of soil which is more yellow than that made by the Mauch Chunk.

AREAL EXTENT, GREENBRIER SERIES.

The Greenbrier Series outcrops in the gap made by North Branch of Potomac River through the mountains between Piedmont and Keyser and thence extends southwestward along the eastern slope of the Allegheny Front through both Mineral and Grant Counties. West of the Allegheny Front it dips under the North Potomac and Stony River Basins and comes to the surface along the western slope of Backbone Mountain in Garrett County, Maryland, and Preston and Tucker Counties, West Virginia, and also along the western slope of Cabin Mountain in the latter county just west of the Grant County Line.

CONTACTS, GREENBRIER SERIES.

The contact of the Greenbrier with the Mauch Chunk above it has already been discussed under the description of the latter series, page 274. Its base rests upon the coarse, cross-bedded, and often conglomeratic sandstones of the Pocono Series which are usually, though not always, free from marine fossils and are typical shore-line deposits. In addition to the abrupt change from coarse sandstone to marine limestone in passing upward from the Pocono to the Greenbrier, there is an apparent absence of many hundreds of feet of Pocono sediments in the two counties, as they do not exceed 600 feet, while a thickness of about 2,000 feet is recorded by Dr. G. P. Grimsley in the Jefferson, Berkeley, and Morgan

Report of the Survey, and if his hypothetical correlation of the Myers Shale with the Pulaski, or Maccrady, Shale of Virginia be correct then it is the upper portion of the Pocono that is missing, indicating an unconformity of some magnitude.

FOSSIL LIFE, GREENBRIER SERIES.

The Greenbrier of West Virginia generally carries a profuse marine fauna and in Mineral and Grant Counties it contains fossils but little opportunity is afforded for their study, due to the usual deeply weathered outcrop as previously mentioned. No collections were made for the present Report, but in the North Potomac Section of Dr. I. C. White, page 145, the identifications of a few species in the gap east of Piedmont are recorded.

ECONOMIC ASPECTS, GREENBRIER LIMESTONE.

The Greenbrier Limestone weathers into a very rich agricultural soil, as may be inferred from the fact that its narrow, outcropping bench along the steep slope of the Allegheny Front is almost entirely cleared out and devoted to farming purposes. It also possesses intrinsic value for many of the purposes to which limestone can be put, as will be further discussed in Chapter XVIII under the subject of "Limestone," at the end of which will be found a Table of Limestone Analyses in which its chemical character is indicated.

POCONO SERIES.

GENERAL ACCOUNT, POCONO SERIES.

The Pocono Series, comprising the lower portion of the Mississippian rocks of northern West Virginia, consists of coarse, gray, cross-bedded sandstones and interbedded gray, sandy shales having tinges of red at some localities. The total thickness appears to vary from 200 to 600 feet, there being 185 feet at Dry Fork, Tucker County, only a few miles west of the southwestern corner of Grant County, and 596 feet in the gap of the Potomac between Piedmont and Keyser, as recorded in the section for the latter place, page 140. In this gap the series is not well exposed, a better view of it being afforded along the road which leads from Keyser to the summit of the Allegheny Front via Thunder Hill Run and Spring Mountain School, where it contains four massive sandstones, the intervals between all of which are composed

of gray shale interlaminated with red. Coals or coaly shales were not observed at any point.

The Pocono of these two counties is a somewhat intermediate phase, as there are points in Tucker County on the west where it has a thickness of only 75 feet or less and in Morgan and Berkeley Counties farther east Dr. Grimsley records a maximum of about 2,000 feet. Only meager evidence is available for an opinion regarding the portion of the series which has persisted westward into Mineral and Grant. Dr. Grimsley, in his Report on Morgan, Berkeley, and Jefferson Counties, has followed the classification of George W. Stose, Charles K. Swartz, and others in the Pawpaw-Hancock Folio (No. 179) of the United States Geological Survey which in part covers the same area, and in which the following Pocono subdivisions, in descending order, are made:

	Thickness. Feet.	Total. Feet.
Pinkerton Sandstone; massive white sandstone and quartz conglomerate, in part cross-bedded, with a thin coal seam	125+	125
Myers Shale; largely bright-red, crumbly, sandy shale and thin argillaceous sandstones with thick, cross-bedded, dirty-gray, gritty sandstone at base	800+	925
Hedges Shale; dark-gray to black carbonaceous shale containing thin seams of semianthracite coal	170	1095
Purslane Sandstone; massive, hard, coarse, white sandstone and milky quartz conglomerate, alternating with softer cross-bedded sandstone with a little shale and thin coal seams, 180′ to	310	1405
Rockwell Formation; soft, arkosic sandstone, fine, hard conglomerate, and buff, hackly shale; crumbly, dark-gray, carbonaceous shale with thin coal seams near the base in western part of area, 500′ to	540	1945

In further detailed sections Stose records the occurrence of occasional red beds in the Rockwell Formation but indicates none in the Purslane Sandstone. Dr. Grimsley, in applying the classification of Stose to his more recent description of the Pocono of Morgan and Berkeley Counties, doubtfully correlates the Myers Shale with the Pulaski Shale of M. R. Campbell, which according to Dr. Geo. H. Girty has been superseded by the Maccrady Shale of Stose. The Maccrady Shale is indicated as an independent formation composed of shaly limestones, soft sandstones and red shales, coming between the Greenbrier Limestone and the "Price

Sandstone" which contains the lower Mississippian coaly beds of southwestern Virginia of apparent Pocono age.

Returning now to Mineral and Grant Counties it would appear that no vestige of the Maccrady (Pulaski) Shale remains and that the Myers Shale, regardless of its possible correlation with the Maccrady, is also absent, and further that the Hedges Shale also has vanished, there being no coals or carbonaceous shale in the Pocono of the two counties. Of the eastern Pocono there then remain the Purslane Sandstone and Rockwell Formation with which the Mineral and Grant Pocono, as well as that of more western counties, may roughly agree. In nearly all of the northern and central counties, as recorded at surface outcrops and in oil wells, there is a heavy conglomerate at the top containing white, quartz pebbles, and toward the bottom a "Coffee Shale" is widely recorded by the drillers, possibly agreeing with the buff shale of the Rockwell Formation. It is true that no pebbles are apparent in the Pocono of Mineral and Grant but good exposures are not common and they might well have been overlooked, and in any case they are abundant in the upper member of the same group in the adjoining county of Tucker.

TOPOGRAPHIC EXPRESSION, POCONO SERIES.

The Pocono of the two counties makes no complete topographic forms, its outcrop being confined to the steep eastern slope of the Allegheny Front. Along this limited belt, however, it is quite conspicuous, as its sandstones, much more durable and resistant than the Mauch Chunk and Greenbrier above it, or the Catskill below it, form a series of low, bench-like knobs jutting out from the general mountain slope and receiving the title of "Fore Knobs."

AREAL EXTENT, POCONO SERIES.

The Pocono outcrops in the gap where North Branch of Potomac River cuts through the mountain between Piedmont and Keyser and thence extends southwestward along the eastern slope of the Allegheny Front through both counties. West of this locality it dips far below drainage under the North Potomac and Stony River Synclines, coming out again along the western slope of Backbone Mountain in Garrett, Preston, and Tucker Counties, as well as being exposed in the Canaan Valley and Red Creek region of the latter county, not far from the Grant County Line. East of the exposure noted along the Allegheny Front its horizon is entirely above the topography in both counties.

CONTACTS, POCONO SERIES.

The contact of the Pocono with the Greenbrier Limestone has already been discussed, an unconformity being mentioned. At its base it rests unconformably on the oxidized red shales of the Catskill Series of the Devonian Period, a long lapse of time and wide exposure to aerial and erosive action being apparent. As the upper portion of the Catskill contains no fossils and the Pocono generally has none, this unconformity is mainly evident from lithologic aspects.

FOSSIL LIFE, POCONO SERIES.

Marine fossils were not observed in the Pocono of Mineral and Grant Counties. The series, in general, does not appear to be fossiliferous in West Virginia, although it has yielded a few shells in Monongalia and Randolph Counties and perhaps at a few other localities in the northern part of the State, and at Bluefield, Mercer County, certain zones of the sandy Mississippian beds lying below the Greenbrier Limestone are abundantly fossiliferous. Whether these correlate entirely with the Pocono remains to be determined. In the maximum West Virginia development of Morgan and Berkeley Counties, the Pocono is not reported as fossiliferous by Dr. Grimsley or by Stose and his associates, but in Pennsylvania, northward from this same region, marine fossils have been recorded at several points by members of the Second Geological Survey of that State.

The shales of the Pocono often contain plant fossils, being usually more abundant in regions where seams of coal are found.

DESCRIPTION OF MEMBERS, POCONO SERIES.

As stated in the General Account of the series, page 281, it would appear as though the Pocono of Mineral and Grant Counties, as well as that of many other counties farther west, may represent the Purslane Sandstone and Rockwell Formation of Stose. These two groups have not been further subdivided at their type localities but in the oil fields of the central and western portions of the State, the sandstone members of the Pocono have been named as follows in descending order:

Big Injun Sand, including a split often found at the top and known as **Keener Sand.**

Squaw Sand, sometimes regarded as a split off the bottom of the Big Injun but preserving a separate identity over wide areas.

Weir Sand, typical of southwestern West Virginia.
Coffee Shale, lying just over Berea Sand and usually recorded as a marker for that horizon.
Berea Sand, or **Berea Grit,** basal member of the Pocono throughout the oil fields.

As previously stated, there are four massive sandstones in the Pocono along the road which leads up the Allegheny Front from Keyser via Thunder Hill Run and these may correlate closely with the four beds of the oil fields, although proof is lacking. Pebbles were observed in none of the ledges along the Allegheny Front but in other counties they usually occur abundantly in the Big Injun and with less regularity in the lower sandstones.

ECONOMIC ASPECTS, POCONO SERIES.

From an economic aspect the Pocono Series of the two counties appears to have little interest. It is true that in the western portion of the State this group contains valuable deposits of oil and gas but for reasons advanced in Chapter XVI it is believed that the prospect of finding them in the immediate vicinity of the Allegheny Mountains is very poor. If desired some of the ledges might be used for rough building stone but their largely isolated outcrop on a sparsely inhabited mountain slope precludes the idea of quarrying them in competition with more accessible and often more desirable stone. The Pocono soil is invariably poor, little attempt being made to farm it in either county.

CHAPTER XI.

STRATIGRAPHY---UPPER DEVONIAN ROCKS.

INTRODUCTION.

Aside from early exploratory notes the first report of general circulation covering a portion of Mineral and Grant Counties is contained in the Piedmont Folio (No. 28) of the United States Geological Survey by Darton and Taff (1896). Their classification of the Devonian is as follows:

Hampshire Formation
Jennings Formation
Romney Shale
Monterey Sandstone (indicated as partly Silurian).

The Piedmont Folio was followed by the Franklin Folio (No. 32) of Darton in the same year, the same terminology and basal Devonian contact plane being used.

In 1912 the Pawpaw-Hancock Folio (No. 179) by Stose and Swartz, covering a portion of the Potomac drainage in Pennsylvania, Maryland, and West Virginia some miles east of Mineral County, was issued, in which the following revision and amplification of the Devonian was made:

Catskill Formation
Jennings Formation
- Parkhead Sandstone Member
- Genesee Black Shale Member

Romney Shale
- Hamilton Arenaceous Shale Member
- Marcellus Shale Member
- Onondaga Shale Member

Oriskany Sandstone
Helderberg Limestone
- Becraft
- New Scotland
- Coeymans.

In 1913 the Maryland Geological Survey issued its very comprehensive study of the entire Devonian of that State by Swartz and others in which the following groupings and subdivisions (Lower Devonian Volume, page 31) were used:

Upper Devonian:
- **Catskill Formation**
- **Jennings Formation**
  - Chemung Member
  - Parkhead Member
  - Woodmont Member
    - Ithaca Fauna
    - Naples Fauna
  - Genesee Member

Middle Devonian:
- **Romney Formation**
  - Hamilton Member
  - Marcellus Member
  - Onondaga Member

Lower Devonian:
- **Oriskany Formation**
  - Ridgeley Member
  - Shriver Member
- **Hedelberg Formation**
  - Becraft Member
  - New Scotland Member
  - Coeymans Member
  - Keyser Member.

In 1916 the West Virginia Geological Survey issued its detailed Report on Jefferson, Berkeley, and Morgan Counties by Dr. G. P. Grimsley in which the Devonian was classified as below:

Upper	**Catskill** **Chemung** **Portage** **Genesee**	(Jennings of United States Geological Survey publications)
Middle	**Hamilton** **Marcellus** **Onondaga**	Romney of United States Geological Survey publications)
Lower	**Oriskany** **Helderberg.**	

It will be noted that in the Piedmont and Franklin Folios names of purely local application were used without any attempt to correlate the measures with typical subdivisions of long standing in North America. In the Pawpaw-Hancock Folio the term "Hampshire" was discarded and in its place was substituted the Catskill of early association in New York State. The formation "Jennings" was retained but under it the Genesee Shale appeared as a member, giving some connection with its New York affiliations. The "Romney" was retained but it was subdivided more according to conventional

usage. Farther down, the Oriskany and Helderberg of New York were restored, with typical subdivisions of the latter.

In the Maryland volume the generally recognized subdivision into Upper, Middle, and Lower Devonian was utilized and certain subtitles of valuable application in the Potomac Valley were introduced, but thick and extensive groups like the Chemung, Hamilton, and Marcellus were relegated to less prominent position than their importance warrants, being kept as subtitles under formation names that are not of typical derivation, while the Portage was not named as such although its fauna was recognized.

In the Jefferson, Berkeley, and Morgan Report, the New York succession is in large part restored without the more recent superficial titles and in the text an attempt is made to revive a part of the early nomenclature of Pennsylvania which is by precedence entitled to rank just after that of New York.

In the present volume on Mineral and Grant Counties it is proposed to follow the Devonian nomenclature of New York as far as may be possible, since it is clearly entitled to precedence, and to recognize the amplifications and additions of other organizations or authors in their proper succession. Under such a convention the Devonian of the two counties has the following succession in descending order:

Upper Devonian:

Catskill Series (1600-2400′)

Chemung Series (2500-3500′)

Shales and Sandstones (streaks of red)
Upper (Lackawaxen) Conglomerate
Shales and Sandstones (streaks of red)
Lower (Allegrippus) Conglomerate
Shales and Sandstones

Portage Series (1700-2000′)

Genesee Series (50-300′)

Middle Devonian:

Hamilton Series (300-1000′)

Marcellus Series (500-800′)

Lower Selinsgrove Limestone in basal portion, two benches totaling 50-100′
Selinsgrove Shale

Lower Devonian:

Oriskany Sandstone (100-200′)

Ridgeley Sandstone
Shriver Chert

Helderberg Limestone (300-600′)

New Scotland Chert
Coeymans Limestone
Keyser Limestone.

Further comment on the Devonian nomenclature will appear in subsequent pages under the descriptions of the various subdivisions.

The Devonian of the two counties will perhaps average 10,000 feet in thickness and comprises more than half of the outcropping rock column and is abundantly exposed over wide areas in the region east of the Allegheny Front, good exposures being available of most portions although much difficulty is experienced in attempting to measure the shaly beds, as they are frequently buckled or duplicated. Marine fossils are present in all the major subdivisions except the Catskill, which is almost invariably non-marine, and the Portage, which appears to be barren in this area. In lithologic aspect shales and lenticular or thin-bedded sandstones predominate in the Upper and Middle Devonian while massive sandstone and pure limestone occur in the Lower.

CATSKILL SERIES.

GENERAL ACCOUNT, CATSKILL SERIES.

The Catskill Series, coming at the top of the Upper Devonian and just beneath the Pocono Series of the Mississippian, is a mass of red shale interbedded with sandstone, its thickness varying from 1,600 to 2,400 feet. Its shales contain occasional thin streaks of pale green color and are usually quite siliceous, due to the frequent inclusion of thin and rotten sandstone bands. Its sandstones are greenish or reddish-brown in color, fine-grained and micaceous, sometimes massive but more often flaggy or cross-bedded, and quite lenticular in occurrence, there being frequent inclusions of shale and sometimes a total merging of sandstone into shale, although there is in general almost as much sandstone as shale.

The series, as generally described, is typical of the Catskill Mountains of New York State and is of wide extent southwestward into Pennsylvania, Maryland, and West Virginia but thins out and disappears in the southwestern portion of the latter State and is not again found in the southern Appalachians. Some able authorities have regarded it as merely a coastal phase of the Chemung, but with this interpretation the writer does not agree because such a classification conveys a totally inadequate idea of its importance in geologic history. The fact of its occurrence in great quantity over a wide area, with an almost total absence of conglomerate or other coastal phenomena, together with the general absence of Chemung fauna except in the limited

transitional zone at the base, and with a complete and definite change in lithologic aspect implying subaerial conditions of long extent, should give it the rank of a major subdivision regardless of its time value. Considered in its broad relationships it represents a time of long exposure to oxidizing agencies, either at the source of the sediments or during their period of passage into their present cycle, where it is probable also that much further exposure occurred. The Catskill stage may be visualized as a time when there were extensive lacustrine areas, poorly connected with, if not entirely shut off from, the Appalachian Sea, and subject to such frequent changes of water-level that the beginnings of both animal and vegetable life were alternately obliterated. Such a condition is in sharp contrast with that which prevailed during the Chemung when sedimentation occurred under uniformly marine auspices, and would in itself preclude the idea of intimate association with the Chemung.

The Catskill of Mineral and Grant Counties is an intermediate phase between that which is found in New York and eastern Pennsylvania and that which occurs along the western border of West Virginia. In eastern Pennsylvania a thickness of 6,000 feet has been noted, and according to Grimsley there is even a maximum of 3,757 feet in Berkeley County, West Virginia, but in Mineral County this has decreased to 2,417 feet and so continues westward until only about 400 feet can be noted in the oil wells of the northwestern part of the State, and even this remnant disappears in passing southwestward toward Kentucky.

Efforts to subdivide the series into members in West Virginia have been fruitless in all the regions of its outcrop that have been studied, but in northeastern Pennsylvania where it contains a few conglomerates and impure limestones, Dr. I. C. White recognized and traced certain definite recurring beds. In Mineral and Grant Counties there is a meaningless repetition of similar sandstones and shales that have no individual peculiarities of positive value. In the oil fields of western Pennsylvania and western West Virginia the sandstone beds have been given names by the drillers, but these have been based on intervals from recognized upper horizons as recorded in numerous wells and even then there is much doubt as to the continuity of the Catskill ledges. In Chapter V its character is noted in the sections for Keyser and Claysville.

Photo by E. E. HARRIS.

PLATE XV.—Low ridge just south of railroad station at Petersburg, made by Marcellus Series. Top of ridge is shale. Base is Lower Selinsgrove Limestone alternating with shaly strata. See Petersburg Section for details.

TOPOGRAPHIC EXPRESSION, CATSKILL SERIES.

The outcropping Catskill of the two counties is confined to the eastern slope of the Allegheny Front and therefore does not afford a complete topographic display. In this locality the dip is westward into the mountain, there being a noticeable benching near the top of the series, followed by a distinct belt of small hillocks that stand out from the middle portion. Farther west in Tucker and Preston Counties where the Catskill has complete topographic forms, it makes a smoothly rounded ridge and slopes that bulge outward without appreciable benches, the entire ridge having much the profile of an inverted U, in sharp distinction to the Chemung which in cross-section closely resembles an inverted V with a sharp ridge line and straight line slopes.

AREAL EXTENT, CATSKILL SERIES.

The Catskill Series outcrops in the gap of the mountains made by North Branch of Potomac River between Piedmont and Keyser and thence extends southwestward along the eastern slope of the Allegheny Front across both counties. East of this exposure it is not present in either county, its horizon being above the present topography. West of the Allegheny Front it dips deeply under the North Potomac and Stony River Basins but reappears along the western slope of Backbone Mountain in Garrett County, Maryland, and Preston and Tucker Counties, West Virginia.

CONTACTS, CATSKILL SERIES.

The contact of the Catskill Series with the overlying Pocono of the Mississippian has already been discussed under the description of the latter series, page 282. At its base where it rests upon the Chemung its true beginning has been the subject of much discussion. At this stage there usually occurs a zone of transition in which some pale red streaks are found interlaminated in the fossiliferous green sandstones and shales of the upper Chemung while occasional olive-green shales recur above in abundant and typical Catskill reds, and in some adjoining regions even fossils of recognized Chemung types have been noted in thin sandstone several hundred feet up in the reds. It is believed by some authorities that the upper limit of the Chemung should be drawn at the last recurrence of fossils regardless of any amount of reds that may be present beneath them but Dr. I. C. White expresses the opinion (in an interview) that the presence of marine fossils in the lower portion of the domi-

nantly red beds may have been due to the local existence of lagoons where conditions favorable to marine life still persisted in spite of the advancing red muds.

In Tucker County, lying west of Mineral and Grant and west of the North Potomac and Stony River Synclines along which the Devonian is deeply buried, there is a rather profuse marine fauna in the thin Hendricks Sandstone of Reger and Price (see Tucker Report, pages 245-251) coming at a variable interval above the base of the conspicuous reds, being at some localities as much as 300 to 400 feet above this plane and at others apparently resting upon it. In Mineral and Grant Counties there is a highly fossiliferous sandstone about twenty feet thick at the base of the main reds which the writer has been inclined to correlate with the Hendricks Sandstone, as recorded in the Keyser Section, page 140, and the Claysville Section, page 153, but Dr. Wm. F. Prouty, to whom collections were sent from two localities of the Hendricks Sandstone in Tucker County and from two localities of the contact rock in Mineral County, expresses the opinion that the Mineral County horizon is older than that of the typical Hendricks, his report on the fossils being as follows:

Locality 223: Along a hill road just east of Falls Run of Dry Fork of Cheat River, immediately north of Hambleton, and 1 mile northwest of Hendricks, Tucker County. Type locality of Hendricks Sandstone. Collection by W. A. Price.

Camarotoechia contracta (Hall), very abundant
Leptodesma medon Hall, very abundant
Leptodesma sp.
Sphenotus cf. contractus Hall, rare
Lingula cf. oherni Clarke & Swartz, common
Palaeanatina sp.
Bryozoa sp., ramose species very abundant and same at locality 212 but too poorly preserved to be determined.

Locality 212: On Close Mountain, 0.1 mile east of Close Mountain School and 1.2 miles southeast of Lead Mine village, Tucker County. Hendricks Sandstone. Collection by Reger and W. A. Price.

Camarotoechia contracta (Hall), very abundant
Sphenotus contractus Hall, common
Bryozoa sp., ramose variety, same as in sandstone locality 223. It occurs here in great abundance.

Locality 1850B-Eg-8-5: On Northwestern Pike, 2.7 miles southwest of Claysville, Mineral County. Extreme top of Chemung. Collection by Earl R. Scheffel and Paul H. Price.

Spirifer disjunctus Sowerby, very abundant
Camarotoechia congregata var. parkheadensis C. & S., very abundant

Camarotoechia contracta (Hall), rare
Leptodesma sp., rare.

Locality 900-K-1-31: In highway cut along Keyser-Piedmont road, 1.6 miles northwest of Keyser Station and at second telephone-pole west of "Z" Tower on B. & O. R. R., Mineral County. Extreme top of Chemung. Collection by Earl R. Scheffel and Paul H. Price.

"This has same fauna as the locality 1850.

"The presence of the Camarotoechia congregata var. parkheadensis in these two localities in Mineral County together with the absence of both Spirifer disjunctus and Camarotoechia congregata var. parkheadensis from the Hendricks Sandstone would point to the probable difference in the time of deposition of the Mineral County sandstone and the Hendricks Sandstone. It would seem that the Mineral County sandstone is slightly lower in the Chemung, though the evidence for this is not very conclusive. There is very little difference in the character of the two sandstones. The evidence would necessarily have to be based upon the two Camarotoechias, C. congregata usually occupying a lower position in the section than C. contracta."

From the interpretation of Dr. Prouty it would appear that the Hendricks Sandstone does not persist into Mineral and Grant Counties and that it may be of a local or sporadic nature and in general could not be considered as defining the contact plane.

FOSSIL LIFE, CATSKILL SERIES.

The outcropping Catskill of the two counties appears to be devoid of animal fauna, indicating a more regular contact zone than is found in Tucker County and other regions where fossils persist upward into the reds. Plant fossils, if present at all, are scanty and poorly preserved.

ECONOMIC ASPECTS, CATSKILL SERIES.

A scrutiny of the Catskill beds of the two counties reveals little that may be considered of economic value except the soil that is made by disintegration of the red shales, and even this requires much fertilizer to make it produce in quantity. Some of these shales might be made into building brick but only that portion of the outcrop in the gap of the Potomac is accessible to rail transporation and expense would be involved in removing frequent lenses of sandstone. The sandstones, as a rule are too shaly or too cross-bedded to make valuable building material.

CHEMUNG SERIES.

GENERAL ACCOUNT, CHEMUNG SERIES.

The Chemung Series of the Upper Devonian, coming just below the Catskill and just above the Portage beds, is a mass

of interbedded flagstones and shales of marine origin, its thickness in the two counties ranging from 2,500 to 3,500 feet. The flags usually vary in thickness from 1 to 7 or 8 inches and are greenish-gray, fine-grained, very hard, and compact, weathering into rectangular or rhomboidal blocks which retain their sharp, clean angles for a long time. In rare instances the flags consolidate into more massive beds, 10 to 15 feet in thickness, but such a condition appears to be local rather than of continued extent. With the exception of a few tinges of red in the upper portion the shales are of a uniform olive-green color, being mostly fissile but occasionally weathering into pencil strips a few inches long. Pure limestone is entirely lacking but there are a few streaks of richly fossiliferous material that contain enough iron to become quite brown on exposure and apparently enough calcareous matter to cause conchoidal weathering.

Evidence of littoral conditions is not uncommon, there being abundant ripple-marks and occasional conglomerates. Of the latter there would appear to be not less than three distinct streaks as there are two recorded in the Keyser Section, page 140, one of which is 208 feet below the top of the series and the other 1,081 feet below the same plane; and in the Claysville Section, still another is noted at the assumed Chemung-Portage contact, 1,424 feet below the top. The matrix of these conglomerates is quite similar to other Chemung sandstones with the exception of being more massive, their included pebbles being of white quartz, small, oblong, and much flattened, and usually arranged in thin belts parallel to the general bedding-planes. Some remarks on the correlation of these conglomerates with those of the Chemung as elsewhere exhibited will be found under the subject of "Subdivisions."

TOPOGRAPHIC EXPRESSION, CHEMUNG SERIES.

The Chemung Series usually makes sharp, narrow ridges, with a general profile like that of an inverted V, separated by normal V-shaped valleys. In weathering, the flagstones and shales shear off evenly so that benches are uncommon where the strata lie level and escarpments are seldom seen in regions of pronounced dip. In general effect the Chemung areas of the two counties form ranges of low hills, 200 to 500 feet, or less often 700 to 800 feet, in height, as contrasted both to the bold mountains made by the Pottsville and Medina Sandstones and to the smooth valleys developed in the soft shales of the Hamilton and Marcellus. Viewed at some distance these hills give a somewhat gentle effect but on close

inspection their highly dissected character and sharp ridge lines become apparent.

AREAL EXTENT, CHEMUNG SERIES.

In Mineral County, as shown by Map II, the Chemung outcrops along that portion of the Patterson Creek Mountain which is closely parallel to the Big Spring Run Syncline, the dividing line between Mineral and Hampshire County being made by this ridge for several miles; also in several large areas along the deep Bedford Syncline; and also along the lower portion of the eastern slope of the Allegheny Front. In Grant County as shown by Map IV, it occurs as the highest formation in Middle Mountain; also along a short sector of the Bedford Syncline lying next to the Mineral County Line; and also along the eastern slope of the Allegheny Front. West of the Allegheny Front it does not outcrop again in either county, being deeply buried under the North Potomac and Stony River Basins, but comes out again in Garrett County, Maryland, and Preston and Tucker Counties, West Virginia, farther west. Along these extensive exposures in both counties there are numerous points where good local outcrops may be inspected but there is no place in either county where favorable opportunity is afforded for measurement of the entire series, there being frequent reversals of dip or duplications due to the incompetent nature of the strata. At the gap of the Potomac east of Keyser the upper portion is well exposed but the lower strata are largely concealed, as indicated in the Keyser Section. The entire series is exposed along the Northwestern Pike, as recorded in the Claysville Section, but the locality is poorly adapted to measurement owing to the zigzag course of the highway and sharp dip of the rocks which together produce baffling recurrences of strata along the only possible line of traverse. The thicknesses recorded at these two localities, 4,047 feet at the Keyser Section as compared to 1,424 feet at the Claysville Section, are clearly out of harmony, and it is believed that there may be concealed reversals or duplications in the lower portion of the former and possibly a disappearance of strata due to overthrust at the latter place.

CONTACTS, CHEMUNG SERIES.

The contact of the Chemung with the overlying Catskill has already been discussed under the description of the latter series, page 289. Its base rests upon the Portage without apparent unconformity, the line of contact having

been assumed as the plane where marine fossils first appear in ascending the strata from the barren Portage. This level is not easily followed, however, as the lower portion of the Chemung is by no means rich in fossils, the most usual forms being the casts of Crinoid stems occurring normal to the bedding of the flagstones and therefore visible only in cross-section. In addition to this scanty marine evidence there are some slight lithologic differences apparent on close observation. In the Chemung, flagstones are more common and of thicker bedding than in the Portage and there is also a barely perceptible change from darker, olive-green shale in the Chemung to lighter, greenish-gray material in the Portage. Taken in conjunction, the fossil evidence, bedding, and colors afford three factors of determination that prove fairly reliable.

In extending the Chemung down to the lowest occurrence of marine fossils the writer has followed the criterion of Dr. Swartz[1] who states that the first appearance of the **Spirifer disjunctus** fauna marks the beginning of the series. A small collection was made in the contact zone on the extreme head of Broad Hollow of Dan Run of North Branch of Potomac River, 5 miles southwest of Green Spring and near the Mineral-Hampshire County Line, the identifications from which have been made by Dr. Tilton as published in Chapter XXI. Besides other fossils of wider range the presence of both **Tropidoleptus carinatus,** one of the characteristic forms of the Parkhead member of the Portage, and **Spirifer disjunctus,** guide fossil of the Chemung, is noted, making it appear that the point selected was the true contact. Beneath this same zone no fossils were found in the Portage, either on Broad Hollow or at any other locality in the two counties, and this harmonizes with the absence of Portage fauna reported by Dr. W. Armstrong Price along the Tucker-Randolph County Line farther west, indicating that the barren area of Portage in northern West Virginia may be quite extensive.

FOSSIL LIFE, CHEMUNG SERIES.

In Mineral and Grant Counties the Chemung Series carries a marine fauna that shows local abundance at various zones throughout the strata but fossils do not occur with the same profusion as is apparent in Tucker and Preston Coun-

[1] C. K. Swartz, Upper Devonian Deposits of Maryland, Maryland Geological Survey, p. 421; 1913.

ties along the valley of Cheat River farther west. They are seldom seen in the shales and are absent from the larger percentage of the flagstones, being usually found in somewhat rotten, ferruginous streaks that occur irregularly between the flags and that contain some traces of lime. In Mineral County the writer made three small collections from the Chemung, one of which was at the upper contact zone, one near the middle of the series, and one at the lower contact. Four more collections of a more extensive nature were later made by Prof. Earl R. Scheffel and Mr. Paul H. Price, two of which are amplifications of the previous collections of the writer, and two are new localities, one being at the top and the other probably 200 to 300 feet below the top of the series. The seven collections made therefore represent five localities and four different stages of the Chemung. No collections were made from the Chemung in Grant County as it did not appear that the fauna differed materially from that of Mineral, and also no attempt was made to secure complete collections from all fossiliferous zones in Mineral County, since there was usually no certain method by which any particular locality could be identified with reference to the top or bottom of the series, due to frequent reversals or duplications of strata. The collections of the writer, as examined by Dr. Tilton, and those of Scheffel and Price, as identified by Dr. Prouty, are assembled in Chapter XXI. Just across the Potomac, also, a systematic study of the Chemung has been made by the Maryland Survey, the paleontology of which should be closely applicable to this area.

The following is a summarized list of all Chemung fossils identified by Drs. Tilton and Prouty from collections in Mineral County:

Atrypa reticularis Linnaeus
Spirifer disjunctus Sowerby
Spirifer mucronatus var. cf. posterus Hall and Clarke
Tropidoleptus carinatus Conrad
Camarotoechia congregata var. parkheadensis Clarke and Swartz
Camarotoechia eximia Hall
Camarotoechia contracta Hall
Leptodesma medon Hall
Ambocoelia umbonata Conrad
Dalmanella tioga Hall
Cyclonema multistriata Prosser and Kindle
Cyclonemina multistriata Prosser and Kindle
Crinoid stems
Gomphoceras ?
Leptodesma cf. lichas Hall
Orthoceras sp.
Cypricardella sp.
Schuchertella cf. chemungensis Conrad
Pelecypod fragments
Productella lachrymosa Conrad
Cf. Loxonema glabium Prosser and Kindle
Loxonema (moulds and casts)
Tentaculites
Coleolus cf. tenuicinctus Hall

SUBDIVISIONS, CHEMUNG SERIES.

Owing to the great lithologic similarity of nearly all stages of the Chemung, no attempt to subdivide it by physical appearance has been entirely successful. According to paleontologic evidence certain fossils range throughout the series while certain other fossils or faunal assemblages either occur wholly in restricted zones or else become noticeably abundant in them, and there is also a well-known succession from older to younger forms in passing upward through the series. In general it would appear a theoretical and scientific possibility to determine with fair exactness the relative position of most stages of the Chemung with respect to the top or bottom of the series, but in practice the lack of easily recognized lithologic peculiarities is a barrier that may not be successfully overcome, since one may not search through several thousand feet of strata for the evidence necessary to correlate each individual outcrop unless the desired information is of first importance, or unless it may be applied to physical differences that hold good over regional areas.

In studies made for the Second Geological Survey of Pennsylvania, Dr. I. C. White (Report G6; 1882) names the **Lackawaxen Conglomerate** as occurring in Pike County in the midst of beds then believed to be of Catskill age, but in a later report (T3; 1885) on Huntingdon County, the same conglomerate is classified as occurring near the top of "Catskill-Chemung Transitional Beds" and as directly overlying a **Spirifer disjunctus** bed, while at the same time a new pebbly member, the **Allegrippus Conglomerate**, is named as occurring at the base of the transitional beds and ranging from 700 to 1,000 feet below the Lackawaxen. Dr. Jno. J. Stevenson (Report T2; 1882) recognizes an Upper and Lower Conglomerate, separated by an interval of 950 feet, in Bedford and Fulton Counties, placing both in the Chemung on fossil evidence, the upper one being 800 feet below the top of the Chemung; and Dr. White seems to consider these two the same as his Lackawaxen and Allegrippus. Dr. C. S. Prosser, also, in the report of the Maryland Survey on the Upper Devonian (pp. 349-351; 1913), describes two conglomerates in the upper portion of the Chemung in western Maryland, one of which comes about 50 feet below the heavy reds taken to be the base of the Catskill, and the other 550 feet below the same plane, but considers that the latter is probably identical with the upper conglomerate of Stevenson, basing his opinion on both faunal evidence and uniformity of interval below the top of the Chemung.

In a paper before the American Association for the Advancement of Science (1891), published after the completion of his report on Bedford and Fulton Counties, Dr. Stevenson makes a general lithologic subdivision of the Chemung, stating that it is applicable to the eastern outcrop from New York to far beyond New River in Virginia, from top to bottom, as follows:

Shales
Sandstone
Shales and sandstone
Sandstone
Shales and flags.

In his report (T2, p. 75) on Bedford and Fulton Counties, he cites a thickness of 2,220 feet for the certain Chemung in Fulton County, Pennsylvania, grouped as follows:

		Feet.	
1.	Shales with occasional beds of sandstone	800	
2.	Sandstone with layers of conglomerate	10	
3.	Shales and sandstones	950	
4.	Sandstone with conglomerate layers	10±	
5.	Shales	450	2220

The harmony of this local phase with his general subdivision is easily recognized. Before leaving his section, however, it should be mentioned that he adds 1,400 feet of "Portage Flags" as member No. 6 and in the context states that it resembles the Portage in lithology but contains only Chemung fossils. From his description, however, it would appear that most, if not all, of these fossils are found only in the upper portion of the 1,400 feet and it would therefore seem that most of this No. 6 is actually Portage, since the Genesee comes just below it and the total absence of Portage could hardly be assumed in this county owing to its recognized presence in adjoining territory. The pebbly beds are usually referred to as the **Upper and Lower Conglomerate.**

In the Upper and Middle Devonian Volume of the Maryland Survey (p. 419; 1913), Dr. Swartz gives the following lithologic sequence and faunal zones as occurring in that State west of Sideling Hill and therefore applicable to Allegany and Garrett Counties, Maryland, both of which adjoin Mineral County, West Virginia:

Upper shale and sandstone beds. **Camarotoechia eximia** zone.
Beds of Jennings type. **Palaeanatina angusta** zone.
Beds of Catskill type.
Beds of Jennings type.
Upper conglomeratic sandstone beds.
Middle shale and sandstone beds.

Lower conglomeratic sandstone beds. **Tropidoleptus carinatus** zone.
Lower shale and sandstone beds. **Dalmanella tioga** zone west of Wills Mountain.

In further description Dr. Swartz states that the lower conglomerate has a fairly constant interval of approximately 600 feet above the base of the Chemung in the region east of Wills Mountain (at Cumberland) and that in the territory west of Wills Mountain a similar conglomerate coming about 300 feet above the base of the Chemung may represent the same horizon, as it contains **Tropidoleptus carinatus.** He also states that the upper conglomerate in the region east of Wills Mountain occurs about 800 feet above the lower conglomerate and that west of Wills Mountain what would appear to be the same ledge is found at 500 to 800 feet below the top of the Chemung.

No statement is made regarding the interval separating the two conglomerates but the thickness of the entire Chemung is declared as varying from 2,000 to 2,300 feet and in two graphic sections published as applicable to the region west of Cumberland there is an average of about 950 feet of strata between the two conglomerates. From the sections given east of Cumberland this interval appears to average about 800 feet, so that in general it is apparent that the interval in Maryland may be taken as 800 to 950 feet which is in close harmony with other statements regarding the total thickness of the Chemung and the position of the two conglomerates with respect to the top and bottom of the group.

In reviewing the statements of these various authorities some general features of common occurrence over an extended area become quite apparent, although there are some discrepancies worthy of note. In western Maryland it appears quite clear that Dr. Prosser, in his conglomerate mentioned as being only 50 feet below the base of the Catskill reds, has recognized a stratum that is higher in the measures than the two which have been described farther east, and this is easily possible since a conglomerate (Hendricks Sandstone) occurs at the very top of the Chemung or perhaps in the Catskill in northern Tucker and southern Preston Counties, West Virginia (as described by Price in the Tucker County Report). Such a view permits the lower conglomerate of Prosser to correlate with the Upper Conglomerate of Stevenson as Prosser concludes that it should. In eastern Pennsylvania it is true that Dr. White has placed his Lackawaxen Conglomerate in the Catskill Series of his Pike County Report and in the transitional Catskill-Chemung in the Huntingdon County Report,

but the presence of Chemung fossils up to the Lackawaxen and even for several hundred feet above it is indicated in his sections and freely admitted in the text, the end of the Chemung in all cases being drawn at the first appearance of red beds, while some other authors have preferred to extend it up to the last appearance of **Spirifer disjunctus** regardless of the presence of reds.

Disregarding for the present the contact phase of the problem it would now appear plain that from northeastern Pennsylvania to southwestern Maryland there are two widely recurring conglomerates, the upper of which comes from 300 to 800 feet below the last appearance of fossils with Chemung affinities, that the interval between these two ranges from 700 to 1,000 feet, and that the lower conglomerate occurs at 300 to 700 feet above the apparent base of the Chemung. It is true that some of these variations in intervals appear large but they are not abrupt, being wholly ascribable to regional changes in the amount of deposition, and hardly so great as might be expected over so wide an area. It would also appear quite plain that all present evidence points to the correctness of the early conclusions of Dr. White that his Lackawaxen and Dr. Stevenson's Upper Conglomerate are the same and that likewise his Allegrippus and Stevenson's Lower Conglomerate are identical.

Passing now across the Potomac into Mineral County, West Virginia, there is found in the Keyser Section a fossiliferous zone at the top of the Chemung in which Dr. Tilton has identified **Camarotoechia eximia**, corresponding in a measure with the highest recorded Chemung fossils of Swartz in Maryland. At 208 feet below the top of the series there is found a four-foot conglomerate corresponding with the Upper Conglomerate (Lackawaxen), and at 1,081 feet below the top of the series or 873 feet below the Upper Conglomerate, there is found another twenty-foot conglomerate that corresponds closely with the Lower (Allegrippus) Conglomerate of Maryland and Pennsylvania. Between the two there occur some bands of red that may well represent the mixed transitional beds of Dr. White in eastern Pennsylvania. Below the Lower Conglomerate at Keyser only 136 feet of Chemung strata are fully exposed but fragmentary outcrops of flagstones containing Chemung fossils continue downward for an interval that would amount to 1,946 feet, provided there are no reversals of dip or duplications, and provided the observed dips constitute a fair average. Such a figure has been indicated in the Keyser Section because that is the

evidence of the visible outcrops but it would appear probable that a measurement under favorable conditions would not show much more than 1,500 feet of Chemung below the Lower Conglomerate.

That conglomerates persist, or at least recur, in the Chemung much farther southwestward is well known. In southern Greenbrier and northeastern Monroe Counties, West Virginia, for instance, there is a very prominent conglomerate in the upper portion, being well exposed along the James River and Kanawha Turnpike, 0.8 mile southeast of Caldwell, Greenbrier County, where it is 75 feet thick, coming about 200 feet below the top of the Chemung and having oblong, flattened quartz pebbles, some of which are as much as 2 inches in length. Whether or not the Lower Conglomerate occurs in this region is not yet a certainty. The locality named is about 150 miles southwest of Keyser.

The Mineral and Grant County phase of the Chemung appears to be slightly abbreviated at the top as compared to some adjoining regions. According to both Stevenson and Swartz the Upper Conglomerate in the general longitude of Cumberland lies 500 to 800 feet below the top of the series, but at Keyser it is only 208 feet below the uppermost appearance of Chemung fossils. In Tucker County, 40 miles or more southwest of Keyser, the writer discovered a sandstone ledge, described as the Hendricks Sandstone, coming in the midst of heavy red shales in the Catskill-Chemung contact zone and carrying a profuse Chemung fauna. This horizon was later traced in detail by Dr. W. Armstrong Price, and, as described by him in the Tucker County Report, was found to have at some localities as much as 200 to 300 feet of reds below it and at others to rest directly on the olive-green Chemung. In order to determine whether or not the highest fossil zone of the Chemung in Mineral County might be the same as this Tucker County horizon, collections from both the Hendricks Sandstone and the Upper Chemung member in Mineral were examined by Dr. Prouty whose verdict is published under the description of Catskill contacts, page 291, his conclusion being that the Hendricks Sandstone contains younger fossils than the upper zone in Mineral County. That there can not be much missing from the top of the Chemung in Mineral County as compared to Maryland, however, would seem reasonably certain from the identification of **Camarotoechia eximia** by Dr. Tilton in another collection made by the writer in the upper zone, since Dr. Swartz lists this fossil as occurring in the highest shales of the Chemung.

ECONOMIC ASPECTS, CHEMUNG SERIES.

The Chemung Series of the two counties offers little in the way of economic products. Some of its flagstones have been used for sidewalk paving in earlier years but can not now compete with concrete or brick, and there are no massive ledges suitable for quarrying masonry materials. Some of the more shaly members could be used in making building brick but are apt to be too siliceous and lacking in plasticity. These shales weather to an extremely thin, yellow soil, quite deficient in fertility and always mixed with many pieces of the flagstones, so that their cultivation for agricultural purposes is not followed by good results, and if used for grazing the land is apt to burn out quickly in dry seasons. In western Pennsylvania and northern West Virginia, oil and gas sands known as the Bradford Group occur in the Chemung but there could be no hope of oil or gas in them in Mineral and Grant where they are exposed to surface evaporation.

PORTAGE SERIES.

GENERAL ACCOUNT, PORTAGE SERIES.

The Portage Series of the Upper Devonian, coming just below the Chemung and just above the Genesee, consists of a monotonous succession of thin and somewhat discontinuous sandstone flags, interbedded with a slightly larger percentage of shales, the total thickness in the two counties ranging from 1,700 to 2,000 feet. The flags vary from 1 to 4 or 5 inches in thickness and are greenish-gray, fine-grained, and moderately hard. The shales are of a uniformly greenish-gray color, fissile, and quite sandy. Limestone and ferruginous layers are lacking entirely and marine fossils do not appear to be present. Conglomerates are not found but the flagstones often have a wavy appearance suggestive of littoral conditions.

Like the other shaly members of the Devonian, the Portage is incompetent under the strains of mountain folding and in the area under discussion has been much distorted, reversals of dip being frequent at many intermediate points between the evident anticlinal axes. Although difficult of proof it would also appear that duplications of strata are somewhat common. Such a state of stratigraphic disorder, in addition to the general similarity from top to bottom, makes the detailed study of this group disconcerting and the recognition or tracing of subdivisions quite impossible. At most

outcrops its thickness can not be measured with any probable certainty, but on Tanners Run of Patterson Creek east of Knobly, Mineral County, its entire succession is well exposed without reversals or concealed intervals of consequence and both top and bottom contacts are visible. A careful measurement at this locality, as recorded in the Knobly Section, page 137, shows a thickness of 1,780 feet. Another measurement, made on the Northwestern Pike at the foot of the Allegheny Front in Mineral County, gives a thickness of 2,058 feet, but at this locality neither the top nor bottom contact is certain and the intermediate strata are not well exposed. Elsewhere in the two counties no point was found where more than a small part of its thickness might be measured.

TOPOGRAPHIC EXPRESSION, PORTAGE SERIES.

The topography formed by the Portage is, in general, much like that of the Chemung except that it is more gentle and the ridges are of less height, but the tendency toward extreme dissection by the minor drainage is quite as well marked. In the major portion of its outcropping area it is much modified by the Chemung which usually forms the upper portions of the ridges and acts somewhat as a cap rock owing to its more resistant character. Viewed in conjunction, the ridges made by the two series are distinct in appearance from those formed by any other association of rocks in the two counties, there being invariable sharp ridge lines, made by the Chemung, and followed on the lower slopes by the more gentle slopes of the Portage.

AREAL EXTENT, PORTAGE SERIES.

In Mineral County, as shown by Map II, the Portage Series outcrops extensively in the general region lying between the Big Springs Run Syncline and the Tussey Mountain Anticline, this territory being mainly tributary to Patterson Creek from the east side but in part bordering directly on North Branch of Potomac River. West of Patterson Creek it is found along the Bean Cove Syncline and Evitts Mountain Anticline most of the way between Reeses Mill and the Grant County Line; and west of the latter uplift it occupies a considerable area on either side of the Bedford Syncline, but with the exception of some of the deeper, transverse drainage channels it is covered along the axis of this basin by the Chemung. Along the great Wills Mountain Anticline and attendant minor folds it belongs entirely above the topog-

raphy but is found again along the foot of the eastern slope of the Allegheny Front, beyond which it remains under drainage in all territory within or adjacent to the county.

In Grant County, as shown by Map IV, it outcrops along either flank of the Middle Mountain Syncline in the region next to the Pendleton County Line and also along the axis of this fold in the region north of the Chemung-capped mountain from which this fold is named, and also along a short sector of the Hiser Syncline which branches from the Middle Mountain Basin. In the central portion of the county it covers a broad belt along the Bedford Syncline from Thorn Run of Patterson Creek southward to Robinson Run of Lunice Creek. Still farther west it occupies a narrow belt along the foot of the eastern slope of the Allegheny Front and then dips under the remaining portion of Grant and most of Tucker County, reappearing again in the Tygart Valley of Randolph County many miles farther west.

CONTACTS, PORTAGE SERIES.

The upper contact of the Portage, with the Chemung, has already been described on pages 293-4. Its lower contact, with the Genesee, is marked by a change from greenish-gray shales and flags to greenish-brown or black, fissile shale almost entirely devoid of flagstones. In the Genesee there are marine fossils but in adjacent regions where both the Genesee and Portage are fossiliferous there is no time break of consequence, the contact in Maryland being described as transitional by Dr. Swartz (Upper Devonian Deposits of Maryland, page 414). The general effect of the lithologic change, also, is hardly as noticeable as the descriptive terms might make it appear.

FOSSIL LIFE, PORTAGE SERIES.

No marine fossils were found in the Portage of the two counties, although a careful scrutiny of the beds was made. In portions of Maryland, however, an abundant fauna is reported in several zones of the Parkhead and Woodmont subdivisions which appear to correlate with the Portage. For a description of these fossils the reader is referred to the volume of the Maryland Survey on Middle and Upper Devonian.

SUBDIVISIONS, PORTAGE SERIES.

As previously mentioned there exists no basis for subdivision of the Portage beds of the two counties, the series

being devoid of any marked lithological changes and also barren of fauna. In Maryland, however, the beds which lie between the Chemung and Genesee and which therefore correspond to the Portage are indicated in descending order as follows by Dr. Swartz in the volume above mentioned, page 411, being classified as "Lithological and Faunal Subdivisions":

Parkhead Sandstone Member. Recurrent **Tropidoleptus carinatus** fauna.
Shale beds
Conglomerate sandstone beds.
Cyclonemina multistriata zone.
Camarotoechia congregata var. parkheadensis zone.
Liorynchus mesacostale zone.
Woodmont Shale Member.
Beds containing Ithaca fauna (**Spirifer mucronatus var. posterus** fauna)
Liorynchus globuliforme zone
Cladochonus-Reticularia laevis zone
Beds containing the Naples fauna (**Buchiola speciosa** fauna).

The Parkhead Sandstone is described as typical of Washington County, Maryland, where it consists of "Shale interbedded with massive, frequently conglomeratic sandstones," varying in thickness from 400 feet in eastern outcrops to 800 feet, west of Green Ridge, with a fauna resembling that of the Hamilton. The Woodmont Shale, which is also named from a locality in Washington County, is described as alternating shales and flagstones, with a thickness varying from 1,600 feet in the eastern sections to 1,200 or 1,300 feet in the sections west of Green Ridge, and containing the Ithaca and Naples faunas in the order named above.

In Report T2 of the Second Geological Survey of Pennsylvania on Bedford and Fulton Counties, Dr. Jno. J. Stevenson describes the "Portage Flags" as 1,400 feet thick and states that no Portage fossils were found at any locality but says that some Chemung forms occur in the upper layers. Dr. Swartz, however, records Parkhead fossils in the vicinity of Allegany Grove, Allegany County, some species being listed as abundant.

ECONOMIC ASPECTS, PORTAGE SERIES.

In the entire Portage Series there is little material that has a known economic value. It contains no coal, iron ore, or limestone, and would certainly be barren of oil and gas in the two counties. Its flagstones could hardly be utilized except possibly in a very limited way for sidewalk paving or as broken road material and its shales are generally too sandy

Photo by E. E. HARRIS.

PLATE XVI.—View along Petersburg-Hopeville road looking west up valley of North Fork of South Branch of Potomac River and through North Fork Gap. Rolling ground in front is made by Hamilton and Marcellus. Knobly Mountain at right middle and its southward extension at left middle are Oriskany slopes. New Creek Mountain in right rear and North Fork Mountain in left rear are capped by White Medina, the sharp point being Chimney Rock. Ridge in extreme background barely visible through gap is Allegheny Front, capped by Pottsville.

for brick manufacture. When disintegrated they make a very thin soil poorly adapted both for cultivation and grazing.

GENESEE SERIES.

GENERAL ACCOUNT, GENESEE SERIES.

The Genesee Series, coming just below the Portage and being the basal group of the Upper Devonian, consists of fissile or laminated shale, black on fresh fracture but weathering to a greenish-brown by loss of included carbonaceous matter. In physical appearance this shale much resembles the Marcellus but differs in being harder and less argillaceous and in a tendency toward splitting at an angle slightly oblique to the bedding-plane so that sharp edges are formed. In the two counties it is entirely devoid of sandstone inclusions and has a thickness that appears to vary from 50 to 300 feet, although its measurement is attended with difficulty owing to its incompetent nature. It is well exposed on Tanners Run of Patterson Creek, Mineral County, just east of Knobly, being recorded as 313 feet in the Knobly Section, page 137. At many other points it is certainly not nearly so thick, although no other measurement was secured. Marine fossils are quite common.

TOPOGRAPHIC EXPRESSION, GENESEE SERIES.

Owing to its lack of bedded sandstone or even flags, the Genesee usually forms no ridges or benches, its outcrop generally merging into the gentle landscapes of the Hamilton and Marcellus, which lie below it and which form most of the valleys or lowlands in the region east of the Allegheny Front.

AREAL EXTENT, GENESEE SERIES.

In Mineral County, as shown by Map II, the Genesee outcrops in several extremely narrow belts, one of which lies east of the Tussey Mountain Anticline and reaches from North Branch of Potomac River southward to the vicinity of Reeses Mill beyond which it forms the surface rocks along the axis for two or three miles, but south of Staggs Run divides into two strips, of which one passes southeastward and winds around the northern ends of the Russelldale Syncline and Beaver Run Anticline, and the other continues southward between Patterson Creek and the Bean Cove Syncline to the Grant County Line. Another belt starts from the Maryland State Line near North Branch Station and extends southward in the general vicinity of the Evitts Moun-

tain Anticline but merges into the strip first described in the vicinity of Reeses Mill. Farther west another outcrop starts from the bend of the Potomac at South Cumberland and thence in a line approximately parallel to Knobly Mountain passes southwestward across the headwaters of several branches of Patterson Creek to the Grant County Line. West of Knobly and New Creek Mountains another strip of this shale starts from the Potomac in the flood-plain north of Keyser and extends southwestward at the extreme eastern foot of the Allegheny Front, reaching the Grant County Line southwest of Laurel Dale.

In Grant County there is a slender outcrop lying about midway between the Elkhorn Mountain Anticline and the Middle Mountain Syncline and another lying west of this syncline and partly following the valley of North Mill Creek but diverging from it in a tortuous course where it crosses the Hiser Syncline and Welton Anticline in the vicinity of Hiser and finally reaching the Hardy County Line about one mile southeast of Welton. Along either flank of the Bedford Syncline there is a strip of Genesee distant one or two miles from the axis and passing southwestward from the Mineral County Line to the vicinity of Robinson Run of Lunice Creek where the two close into a loop. West of the Wills Mountain Anticline the outcrop at the extreme eastern foot of the Allegheny Front described as crossing the Mineral-Grant County Line near Laurel Dale passes southwestward to the Pendleton County Line beyond Hopeville.

CONTACTS, GENESEE SERIES.

The contact of the Genesee with the Portage above it has already been discussed on page 303. At its base it rests usually upon the rusty brown shales of the Hamilton Series which may be distinguished both by their color and by their highly irregular fracture, as well as by the change in marine fauna. In some localities, also, there is a dark, carbonaceous limestone of nodular character, coming in the contact zone and apparently occupying the position of the Tully Limestone of New York, but a collection made from this horizon by Scheffel and Price on Lunice Creek just east of Maysville and another by the same parties on North Mill Creek in the vicinity of Landes, both in Grant County, revealed no Tully fossils according to Dr. Prouty whose lists appear in Chapter XXI. The fauna at the former locality is reported as Hamilton and at the latter as Genesee, so that it would appear that nodules of lime occur in both series at the contact zone. So far as known the Tully Limestone has not been

identified southwest of northeastern Pennsylvania where Dr. I. C. White reports it in Pike and Monroe Counties. Its presence as a transitional rock between the Upper and Lower Devonian in New York and its absence from the section in Mineral and Grant Counties is sufficient evidence of unconformity in the latter region, aside from any time break that may exist between the Genesee and Hamilton.

FOSSIL LIFE, GENESEE SERIES.

The Genesee of the two counties contains an abundant marine fauna, the organisms being mostly small cephalopods and pelecypods. From a collection made by the writer on Staggs Run west of Headsville, Mineral County, Dr. Tilton reports large numbers of **Styliola fissurella,** a form which occurs in great abundance in the Genesee in New York but is not confined to this group. The presence of **Grammysia subarcuata** and **Tornoceras angulare,** however, which are found only in the Genesee, is noted, together with several other common Genesee fossils. Dr. Tilton's list and comment, together with another collection made at the same locality and three others at two more localities by Scheffel and Price and identified by Dr. Prouty, will be found in Chapter XXI.

The following is a summarized list of all Genesee fossils collected in both counties:

Lingula spatula Vanuxem
Grammysia subarcuata Hall
Paracardium doris Hall
Styliola fissurella Hall
Styliolina fissurella Hall
Bactrites aciculus Hall
Cf. Bactrites aciculum Hall
Tornoceras uniangulare Conrad
Pterochaenia (Lunulicardium) fragilis Hall
Pterochaenia fragilis var. orbicularis Clarke
Buchiola sp.
Buchiola retrostriata Von Buch
Buchiola cf. liviniae Clarke
Probeloceras lutheri Clarke
Nucula sp. near N. corbuliformis Hall
Diaphorostoma sp.
Liorynchus sp.
Straparollus sp.

ECONOMIC ASPECTS, GENESEE SERIES.

The chief economic value of the Genesee sediments would appear to be as a soil maker, since they disintegrate into a rich loam that is easily cultivated. It is also probable that these shales could be used for the manufacture of building brick, since they contain little or no lime and the black organic matter is only fractional in amount and would pass off in the kiln with only a small amount of fire shrinkage from this impurity.

CHAPTER XII.

STRATIGRAPHY---MIDDLE DEVONIAN ROCKS.

INTRODUCTION.

The Middle Devonian Rocks, as indicated by the classification adopted for the Devonian in this volume, page 286, include the Hamilton and Marcellus Series, with a combined thickness that probably varies from 1,000 to about 1,800 feet within the area. The prevailing type of these sediments is shale, although calcareous concretions are frequently found near the top and a considerable thickness of impure limestone is usually present near the base. Sandstone, so far as observed, is totally lacking. Both groups are abundantly marine and also differ perceptibly in lithology so that little difficulty is encountered in distinguishing contacts. These two series, together with the Genesee of the Upper Devonian, are entirely confined to the valleys and lowlands, there being no zones with sufficient resistance to form ridges or mountains.

HAMILTON SERIES.

GENERAL ACCOUNT, HAMILTON SERIES.

The Hamilton Series, coming at the top of the Middle Devonian, consists primarily of a yellowish-brown, muddy shale, characterized by innumerable joint- or cleavage-planes which may pass through its mass in any direction but which are usually short and discontinuous without any sustained interrelationship or arrangement. These surfaces are usually quite smooth but exhibit no signs of scoriation such as is common in slickensided shales. On weathering the irregular blocks break transversely, with a rough surface, so that the fragments may have two or more smooth sides, due to the primary cleavage, and others that are uneven. This contrast in surfaces would make it appear that the original jointing took place while the material was still in the state of a somewhat plastic mud. The shale is quite sandy and crumbles readily under the blow of a light hammer, there being in-

sufficient argillaceous matter to give it tenacity or to make it puddle when moistened. It contains no bedded or flaggy sandstones in either county but there are occasional concretions of impure limestone, and marine fossils are common throughout the entire mass. In thickness the series appears to vary from 300 to 1,000 feet but accuracy of measurement can not be claimed at any single point in either county, the shales usually being in part buckled and distorted and in part concealed. It is recorded in the measured sections for Ridgeville and Claysville, Mineral County, and Maysville, Grant County.

TOPOGRAPHIC EXPRESSION, HAMILTON SERIES.

Throughout the two counties the Hamilton Series occupies an intermediate zone between the ridges and mountains made by arenaceous formations and the valleys made by the soft shales of the Marcellus, its expression being sometimes in the form of smooth slopes but quite often characterized by a wide lowland bench, the surface of which is made uneven by the transverse drainage. Ridges are uncommon but when present are invariably low and smoothly rounded.

AREAL EXTENT, HAMILTON SERIES.

In Mineral County, as shown by Map II, the Hamilton Series outcrops on either side of the zone of uplift of which the Tussey Mountain Anticline is the central part, the two belts extending southwestward from North Branch of Potomac River to the neighborhood of Davis School where they unite across the descending axis of this fold and so continue up the Patterson Creek Valley to a point just beyond Reeses Mill and then become covered by the Genesee. South of Staggs Run the series again comes to the surface and in the vicinity of Burlington covers not only the Tussey Mountain Anticline and the Patterson Creek Valley but also extends eastward across portions of the Russelldale Syncline and the Beaver Run Anticline, the outcrop being continuous up Patterson Creek to the Grant County Line. Farther west another long exposure occurs near the eastern base of Knobly Mountain, starting at South Cumberland and extending southwestward by way of Knobly, Ridgedale, and Antioch to the Grant County Line. West of the Wills Mountain Anticline there is another strip of Hamilton starting at Keyser and passing southwestward up the western side of the New Creek Valley to the Grant County Line southwest of Laurel Dale.

In Grant County, as shown by Map IV, the Hamilton outcrops on the waters of South Mill Creek at the foot of the

steep structural slope west of the Elkhorn Mountain Anticline and also on North Mill Creek west of the Middle Mountain and Hiser Synclines where the strata rise again toward the Cave Mountain fold. With the exception of the immediate valley of South Branch west of Petersburg, where the surface is eroded into the Marcellus, this latter belt of Hamilton extends northeastward up the valley of Lunice Creek and down Patterson Creek to the Mineral County Line, its outcrop lying about midway between the Patterson Creek Mountain Anticline and the Bedford Syncline which are the dominant structural features of this portion of the county. In the region just north of South Branch of Potomac and south of Robinson Run of Lunice Creek, however, the Hamilton extends westward across the Bedford Syncline, Royal Glen Anticline, and Blue Rock Syncline to the foot of Knobly Mountain where it turns northeastward and extends to the Mineral County Line by way of Maysville and Martin. With this latter outcrop there is a highway from Corners, on South Branch of Potomac, Grant County, running northeastward approximately 50 miles to South Cumberland, having been built almost entirely on the Hamilton outcrop, in apparent recognition of the fact that the shales of this series make an almost ideal natural road-bed, being porous and self-draining and seldom muddy. West of the Wills Mountain Anticline the Hamilton outcrop extends from the Mineral County Line in the vicinity of Laurel Dale southwestward approximately along the foot of the eastern slope of the Allegheny Front to the Pendleton County Line, passing a little west of Scherr, Streby, Jordan Run, and Hopeville.

CONTACTS, HAMILTON SERIES.

The contact of the Hamilton with the overlying Genesee and the transitional limestone which occurs in this zone have already been discussed, page 306. At the base of the series there is a change from the brown, arenaceous, and irregularly broken Hamilton to the black, fissile, carbonaceous, and argillaceous Marcellus that may usually be followed without difficulty. In marine life there is also a noticeable change from the rich fossil beds of the Hamilton to the comparatively barren upper portion of the Marcellus but several species persist across this plane so that such time break as there may be is hardly sufficient to be called an unconformity.

FOSSIL LIFE, HAMILTON SERIES.

The Hamilton at nearly all stages in the two counties contains a profusion of marine fossils. In addition to brachi-

opods, pelecypods, and gastropods there are crinoids, bryozoa, cephalopods, trilobites, and also corals in much abundance at some localities. The nature of the material is such that collections may be made rapidly, as any desired piece of shale may be chiseled out, but there has apparently been much leaching by percolating water so that delicate structures are often injured or entirely destroyed. Five collections from various stages of the Hamilton were made by the writer and seven others by Scheffel and Price, some of which are amplifications of the original five. The reports on all these collections by Drs. Tilton and Prouty will be found in Chapter XXI.

The following is a summarized list of all Hamilton fossils identified by Drs. Tilton and Prouty in the two counties, one collection from Pendleton County, and another from Allegany County, Maryland, being included:

Athyris spiriferoides Eaton
Atrypa spinosa Hall
Atrypa reticularis Linnaeus
Ambocoelia umbonata Conrad
Spirifer sp.
Spirifer medialis Hall
Spirifer cf. mucronatus Conrad
Spirifer granulosus Conrad
Spirifer sculptilis
Spirifer fimbriatus Hall
Spirifer mucronatus Conrad
Spirifer cf. consobrinus d'Orbigny
Loxonema hamiltoniae Hall
Leptaena rhomboidalis Wilckens
Orthoceras sp.
Orthoceras cf. subulatum Hall
Chonetes lepidus Hall
Chonetes mucronatus Hall
Chonetes sp. cf. C. coronatus Conrad
Chonetes marylandica
Cf. Chonetes vicinus Castelnau
Chonetes cf. lepidus Hall
Chonetes sp.
Palaeoneilo close to marylandica Prosser
Palaeoneilo emarginata Conrad
Palaeoneilo tenuistriata Hall ?
Fenestella sp.
Parazyga sp.
Meristella sp.
Favosites sp.
Favosites cf. gothlandicus Goldfuss ?
Crinoid stems sp.
Tropidoleptus carinatus Conrad
Productella cf. spinulicosta Hall
Stropheodonta cf. perplana Conrad
Stropheodonta inaequistriata Conrad
Rhipidomella leucosia Hall
Rhipidomella sp.
Taeniopora sp.
Fenestella sp.
Camarotoechia cf. prolifica Hall
Actinopteria decussata Hall
Pleurotomaria (Gyroma) cf. capillaria Conrad
Pleurotomaria sp.
Nucula sp.
Nucula bellistriata Conrad
Heliophyllum halli E. & H.
Heliophyllum confluens Hall
Phacops rana Green
Synoptophyllum sp.
Eridophyllum sp.
Orthis penelope Hall
Dalmanites boothi Green
Platystoma cf. euompholoides Conrad
Cup coral sp.
Orthonota sp.
Grammysia sp.
Modiomorpha ?
Stereolasma rectum Hall
Macrochilus hamiltoniae Hall
Monticulipora (?) marylandensis Prosser
Nuculites triquiter Conrad
Aviculopecten princeps Conrad
Streptelasma (?)
Hernodia humifusa Hall
Cystiphyllum americanum Milne-Edwards and Haime.

SUBDIVISIONS, HAMILTON SERIES.

Attempts to subdivide the Hamilton Series have been made by several geologists but the regional variation of the lithology and the apparent continuity of many of its type fossils from bottom to top have prevented the correlation of any one author from becoming general. Hall[1], in his early report on the Middle Devonian apparently established no lithological or faunal zones in the Hamilton, but White[2] divided it as follows in Huntingdon County, Pennsylvania:

	Feet.
Upper Shales	250
Upper Sandstone	30
Middle Shales, soft, gray (lowest beds fossiliferous)	225
Lower Sandstone, hard	50
Lower Shales and Shaly Sandstone	75

In a later report pertaining to the vicinity of Lake Erie, Grabau[3] indicates the following succession for the Hamilton Stage, the superformation being the Genesee and the subformation the Marcellus:

Moscow or Upper Shales
Encrinal Limestone
Hamilton or Lower Shales.

The "Index to the Stratigraphy of North America," page 297, is authority for the statement that the present nomenclature of the New York State Survey for the Hamilton according to Dr. John M. Clarke (1907) is as follows:

Moscow Shale
Ludlowville Shale
Skaneateles Shale.

It will be noted that each of these eminent authorities indicates a different succession, the inference being that the Hamilton in New York is in general composed of shale but contains limestone in the Lake Erie region, while in northeastern Pennsylvania limestone is again absent but some heavy sandstones are present.

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[1] James Hall, Geology of New York, Part 4, Geology of the Fourth District, Albany, 1843, pp. 184-186. Quoted from Index to the Stratigraphy of North America, pp. 302-303.

[2] I. C. White, Report T3, Sec. Geol. Survey of Pennsylvania, p. 105; 1885.

[3] A. W. Grabau, Sixteenth Ann. Report, N. Y. State Survey, pp. 233-240; 1899.

In Maryland, Prosser[4] states that the Hamilton is approximately 1,000 feet thick and is composed of shales and sandstones, there being two or more sandstones of which one is near the top and another is "From 850 to 1,050 feet above the base of the formation," meaning, of course, the base of the Romney Formation as employed by the Maryland Survey, and he also states that a conglomerate is found about 175 feet below the top of the Hamilton in the sections east of Hancock, but no further attempt at zoning is made.

In the Jefferson, Berkeley, and Morgan Report of the West Virginia Geological Survey (1916), Dr. G. P. Grimsley does not attempt to apply previous nomenclature to the Hamilton but gives several sections in which some rather heavy sandstones are present, indicating in a measure that the lithology is similar to that of Maryland. In one section measured on the Potomac north of North Mountain (p. 213), he records a 50-foot sandstone at the top of the series with "Some nodular concretions in it," which is of interest in the present discussion.

In Mineral and Grant Counties, as stated above, bedded sandstones and even flagstones are entirely lacking in the Hamilton. Limestones, except for occasional concretions, are not found in the main body of the series but at the extreme top there occurs at some localities a dark, highly fossiliferous limestone, present in the form of good-sized nodules scattered through 1 to 5 feet of brown shale. It is proposed to designate this member as the **Landes Limestone** from its occurrence in the public road along North Mill Creek, 0.2 mile north of Landes, southern Grant County, where it has an elevation of 1,115′ B. At this point Scheffel and Price made a collection of fossils at the suggestion of the writer in the belief that it might possibly correlate with the Tully Limestone of New York, but Dr. Prouty, who identified the fossils, as recorded in Chapter XXI, makes the statement that it contains no Tully fossils but that it is of Hamilton age. Another collection made by Scheffel and Price on Lunice Creek one-third mile east of Maysville, Grant County, in the same supposed horizon, also revealed no Tully fossils, according to Dr. Prouty, but showed close affiliation with the Genesee. From this conflicting evidence the inference would be that there may be two limestones in this zone, one of which is in the Genesee and the other in the Hamilton, or that there is one

[4] C. S. Prosser, Middle and Upper Devonian, Maryland Geological Survey, pp. 50-51; 1913.

limestone of transitional age in which sometimes fossils of the Genesee and sometimes fossils of the Hamilton predominate. From the known outcrops the writer is inclined to the latter view.

ECONOMIC ASPECTS, HAMILTON SERIES.

The Hamilton Series contains no minerals or products of known commercial importance but its shales disintegrate into a soil that is admirably adapted for agricultural purposes, being free from ledges and boulders and having such a gentle topography that much of it can be cultivated with modern labor-saving machinery. The natural soil is of only moderate fertility but by the use of commercial fertilizer or by the raising of preliminary nitrogenous crops it becomes highly productive.

A sample (No. 578R) was collected from the Hamilton Shale in Mineral County on Tanners Run of Patterson Creek, at an outcrop in the public road at the Short Gap School lot just southwest of Knobly, which shows the following analysis according to Kaplan:

	Per cent.
Silica (SiO_2)	50.78
Ferric Iron (Fe_2O_3)	10.53
Alumina (Al_2O_3)	37.04
Lime (CaO)	trace
Magnesia (MgO)	0.18
Phosphoric Acid (P_2O_5)	0.16
Loss on Ignition	2.10
Total	100.79

From the above analysis it would appear that this shale could be used in making brick for building purposes, as its ignition loss is very low and there is only a trace of lime. It seems probable that the alumina content at this point is greater than many other analyses would show.

MARCELLUS SERIES.

GENERAL ACCOUNT, MARCELLUS SERIES.

The Marcellus Series, coming next below the Hamilton, and, as herein classified, occupying the interval between the latter and the top of the Oriskany Sandstone, outcrops abundantly in the two counties. It consists in general of black, fissile shale, having exceedingly smooth bedding-planes that frequently exhibit a sort of metallic lustre, especially when subject to abnormal pressure such as is apt to occur in mountainous regions. The black color is due to included

carbonaceous or bituminous matter which partly leaches out when exposed to long weathering, the edges of the shale particles first becoming gray and the color gradually extending inward. The argillaceous content is considerable, as the shale is easily churned into a sticky clay in wet weather, and ferric iron is also present in some quantity, being frequently oxidized into rusty brown flakes on exposed surfaces.

In the lower half of the group there is usually a dark, siliceous, and carbonaceous limestone, often occurring in two benches that together occupy an interval of 50 to 100 feet, although at some localities it is much less. When there are two benches of this limestone the space between them is usually occupied by a gray, calcareous shale. Below the limestone the interval down to the Oriskany is composed of shale that mainly has the typical black color and appearance of the Marcellus, although lighter shale is sometimes present. The entire thickness of the series is from 500 to 800 feet, being 503 feet at Claysville, 573 feet at Ridgeville, and 914 feet at Antioch, Mineral County, and 835 feet at Maysville, Grant County. Marine fossils are found throughout but are much more common in the lower portion.

As above described the series will no doubt be recognized as the possible equivalent of both the Marcellus and Onondaga of New York, which may be the case, but the differentiation between Marcellus and Onondaga at the many outcrops would have required much more paleontologic field service than was available or than would seem to be justified by the results to be obtained, so that the entire group has been mapped as Marcellus. Furthermore it has not been definitely established to the satisfaction of all that the New York Onondaga is actually present in the Potomac region. Remarks and conclusions on the correlation of the various members will be found under the subject of "Subdivisions."

TOPOGRAPHIC EXPRESSION, MARCELLUS SERIES.

Being soft, argillaceous, and therefore weathering rapidly, the Marcellus is wholly incompetent and is only found in the valleys. The limestone in the lower portion, however, is durable enough to make occasional small hillocks at protected localities.

AREAL EXTENT, MARCELLUS SERIES.

In Mineral County, as shown by Map II, the Marcellus outcrop in the Patterson Creek Valley from Patterson Creek Station southwestward to the vicinity of Davis School, and

east of the Patterson Creek Ridge it is found again in a long strip which extends from the Potomac southwestward to a junction with that just described and also in another isolated locality along the Potomac at the extreme northern end of the ridge. Farther south it is found in the vicinity of Russelldale and northeastward therefrom for a few miles along the Mineral-Hampshire County Line. Southwestward from the region of Russelldale it outcrops in the valley of Patterson Creek all the way to the Grant County Line. Farther west a long outcrop follows the southeastern base of Knobly Mountain all the way from South Cumberland to the Grant County Line, and west of New Creek Mountain there is another similar strip starting at Keyser and generally following the valley of New Creek to Grant County.

In Grant County, as shown by Map IV, there is a strip of Marcellus at the foot of the northwestern slopes of Spring Mountain and Elkhorn Mountain. Another starts at the Grant-Hardy County Line one-half mile south of Welton, passes southwestward to the vicinity of Hiser, thence northward to South Branch of Potomac, occupying this entire valley in the environs of Petersburg and also westward to the mouth of North Fork. In addition to this broad outcrop in the immediate Potomac Valley there is an extensive belt passing up Lunice Creek to Seymourville, and thence veering slightly eastward in conformity with the structural slope, reaching the head of Patterson Creek in the vicinity of Lahmansville and Forman, and thence following the same closely to the Mineral County Line. At the southern end of Patterson Creek Mountain there is also a small connected area lying east of the Cave Mountain Anticline, and in the vicinity of Medley there is another offshoot and some small isolated areas caused by a small depression in the structural slope west of Patterson Creek Mountain. Immediately southwest of Petersburg a strip of Marcellus extends from the valley southwestward through the lowlands, touching North Mill Creek at Pansy and the Pendleton County Line near Edgewood School. Farther west there is a long outcrop at the southeastern foot of Knobly Mountain, starting at the Mineral County Line and following southwestward to the end of this mountain near Corners. Farther south the outcrop becomes involved, there being some short tongues which extend up tributaries of South Branch in the vicinity of Royal Glen Mill, and another up the narrow valley of South Branch to Shirk Gap. On the west side of New Creek Mountain there is a long strip continuing from the Mineral County Line in

the neighborhood of Laurel Dale southwestward by way of Scherr, Streby, and Jordan Run to Hopeville and thence approximately with the narrow valley of North Fork to the Pendleton County Line.

CONTACTS, MARCELLUS SERIES.

The contact of the Marcellus with the Hamilton above it has already been discussed, page 310. At its base the group herein classified under the general name of Marcellus rests upon the coarse and massive Oriskany Sandstone, the change from black or gray shale to sandstone being abrupt without any interbedding or transitional sandy material. In addition to the change in lithology there is a corresponding difference in fauna, as shown by lists published in Chapter XXI. Both of these factors indicate a considerable unconformity which is further proved by the fact that in New York State the Schoharie and Esopus Grits lie between the Onondaga and the Oriskany. Neither of these members is found in Mineral and Grant Counties and it may also be possible that the major portion of the Onondaga is absent, as its typical flintstones and corals are not found.

FOSSIL LIFE, MARCELLUS SERIES.

The Marcellus Series is of marine origin, being usually characterized by the presence of **Liorynchus limitare** and **Liorynchus mysia,** according to Dr. Swartz (Middle Devonian of Maryland, page 98). In Mineral and Grant Counties, however, the latter fossil is not reported by Drs. Tilton and Prouty but the former is often present. In the upper portion of the series the marine life is much less abundant than in the lower and middle portions where impure limestones are found.

Three collections were made by the writer, principally in the two benches of the Selinsgrove Limestone and its associated shales, and eleven collections were made by Messrs. Scheffel and Price nearly all of which are also in the limestone and adjacent shale but a few of them extend upward into the main body of the black shale. The reports of Drs. Tilton and Prouty on these collections are published in Chapter XXI.

The following is a summarized list of all fossils identified from the Marcellus Series in the two counties by Drs. Tilton and Prouty, there being two collections included from Allegany County, Maryland:

Aviculopecten princeps Conrad
Aviculopecten sp.
Buchiola halli Clarke
Chonetes cf. scitulus Hall
Chonetes sp.
Chonetes close to C. vicinus Castelnau
Chonetes cf. coronatus Conrad
Liorynchus cf. laura Billings
Liorynchus laura Billings
Liorynchus limitare Vanuxem
Nucula corbuliformis Hall
Nucula bellistriata Conrad
Nucula cf. corbuliformis Hall
Nuculites oblongatus Conrad
Nuculites modulatus Kindle
Nuculites sp. close to N. modulatus Kindle
Nuculites sp.
Bellerophon sp.
Phacops rana Green
Phacops sp. close to P. rana
Spirophyton
Tentaculites bellulus Hall
Tentaculites sp.
Ambocoelia umbonata Conrad
Ambocoelia virginiana Prosser and Kindle
Probeloceras lutheri Clarke
Cf. Probeloceras lutheri Clarke
Modiomorpha sp.
Loxonema sp.
Loxonema sp. nov., resembles L. hamiltoniae, also L. rectistriatum
Loxonema hamiltoniae Hall
Rhipidomella sp.
Styliolina fissurella Hall
Anoplotheca cf. acutiplicata Conrad
Anoplea nucleata Hall
Gastropod fragments
Crinoid stems
Crytolites metula Hall
Stereolasma rectum Hall
Stereolasma cf. rectum Hall
Stereolasma sp.
Coleolus tenuicinctus Hall
Coleolus cf. tenuicinctus
Orthoceras sp.
Orthoceras subulatum Hall
Orthoceras close to O. scintella
Orthoceras sp. like O. subulatum Hall
Orthoceras cf. scitula Hall
Cyclora sp.
Stropheodonta sp.
Tropidoleptus carinatus Conrad
Productella sp.
Orbiculoidea sp.
Bactrites aciculum Hall
Bollia ungula Jones
Bollia sp.
Pholidops hamiltoniae Hall
Cf. Pholidops hamiltoniae Hall
Conularia cf. undulatus Conrad
Palaeoneilo sp.
Cf. Spyroceras crotalium Hall
Atrypa spinosa Hall
Atrypa reticularis Linnaeus
Proteus sp.
Panenka sp. nov. close to P. dichotoma Hall
Parodiceras discoideum Conrad
Cup coral sp.
Dalmanites sp.
Dalmanella sp.
Camarotoechia sp.
Anoplotheca sp.
Lingula sp.

SUBDIVISIONS, MARCELLUS SERIES.

As previously stated, the upper bed of black shale, varying from 300 to 600 feet in thickness, is composed of black, fissile shale, without sandstones or limestones and without recognizable lithologic variation from top to bottom. It appears to be this upper portion to which the term Marcellus has been limited by the Maryland Survey, mainly on the verdict of Kindle, but this interpretation is not accepted by Drs. Swartz and Prosser without some reserve. In Mineral County these black shales have a thickness of 327 feet at Ridgeville, 448 feet at Claysville, and a still greater thickness at Antioch where the calcareous members were largely absent. In Grant County they have a thickness of 425 feet at Maysville.

In the lower half of the group the lithology is somewhat variable, there being at many points two limestones of considerable thickness, separated by grayish, calcareous shale, and followed below by more black or gray shale, but at times one or both of these limestones may thin out almost completely leaving only nodular concretions or a little gray shale. These lower beds have been correlated as Onondaga by the Maryland Survey on the basis of faunal determinations by Kindle, although Prosser evidently failed to find Onondaga fossils in that State and Dr. Swartz questions the propriety of calling these beds Onondaga but does so in deference to the usage of the United States Geological Survey, saying at the same time that it might be well to give them a new name.

In northeastern Pennsylvania, a description of the Marcellus and associated rocks is contained in several reports made for the Second Geological Survey of that State by Dr. I. C. White. In Pike and Monroe Counties (Report G6; 1882), he recognizes the Corniferous Limestone of Onondaga age, but in Northumberland and other counties (Report G7; 1883), he finds a limestone at the base of the Hamilton which he names the **Selinsgrove Upper Limestone** and another at the base of the Marcellus which he names the **Selinsgrove Lower Limestone.** Of these two limestones the upper is of no interest in connection with the territory of this Report as it is apparently not represented. Of the Selinsgrove Lower Limestone he gives the following description (page 79):

"**Selinsgrove Lower Limestone,** a hard light gray rock, somewhat impure, in layers 1'-3' thick, interstratified with thin gray shale containing at 15' above base large numbers of **Leptocoelia acutiplicata, Ambocoelia umbonata,** and in less numbers, **Strophomena rhomboidalis, Pleurotomaria** sp?, and **Zaphrentis** sp?; thickness, 65'."

Beneath this limestone he finds 140 feet of **Selinsgrove Shale,** described as light gray, slightly calcareous and having no fossils, below which is the Oriskany Sandstone. Speaking further of the Selinsgrove Lower Limestone he says (pages 80-81):

"This lower limestone seems to occupy the horizon of the Corniferous Limestone; but its one Corniferous fossil, **Leptocoelia acutiplicata,** is more than offset by the Hamilton form **Ambocoelia umbonata.**

"So that taking all the evidence into account, the character of the limestone, etc., the weight of testimony would be in favor of its **Hamilton** age rather than **Corniferous.** It thus seems to represent the **gray Marcellus beds** which in Pike and Monroe are everywhere found 400'-500' thick, resting on the **Corniferous Limestone,** and overlain by the black beds."

It is well here to recall that in the report cited, as well as in many others published about this time, the term "Hamilton" was used both as a superformation name to include everything from the top of the Genesee down to the base of the Marcellus and also as a subformation corresponding to its present accepted usage, so that the limestone is evidently assigned to Marcellus rather than Hamilton age as now understood and generally limited.

In Mineral and Grant Counties the collections do not record **Leptocoelia (Anoplotheca) acutiplicata** at any stage of the beds herein included under the Marcellus but **Ambocoelia umbonata** is reported by Dr. Prouty as abundant or common both in the black shales and also in the calcareous members. In other collections made by the writer in the calcareous beds or in shales closely associated with them, Dr. Tilton reports **Ambocoelia virginiana** which is a Marcellus form, and **Buchiola halli** which is reported from the Onondaga of Maryland but not from that of New York. The Maryland Survey, on the other hand, reports **Anoplotheca (Leptocoelia) acutiplicata** in abundance from the lower beds. From these mixed associations there would appear to be much doubt as to whether the calcareous beds may be definitely placed without reserve either in the Marcellus or Onondaga columns. Most certainly they have little in common with the Corniferous Limestone, under which title the cherty and coral-bearing member of the Onondaga has long been known. It is apparent, however, that the limestone beds correspond quite closely with the Selinsgrove Lower Limestone of White, both in lithology and faunal content, and that the shale lying below the limestones is the same as his Selinsgrove Shale, although this latter is without paleontologic implication at its type locality. Under this interpretation the beds lying between the Hamilton Shale and Oriskany Sandstone in Mineral and Grant Counties have the following classification in descending order:

Marcellus Series:	Feet.
Black shale, with typical Marcellus fauna and lithology	400 to 550
Limestone, **Lower Selinsgrove,** carbonaceous and often occurring in two benches, each having a thickness of 20 to 40 feet and separated by black fissile, or gray calcareous shale; all carrying a mixed Marcellus and Onondaga fauna; total thickness	50 to 100
Shale, **Selinsgrove,** usually black and fissile but occasionally gray and calcareous; mixed Marcellus and Onondaga fauna	50 to 150

Photo by E. E. HARRIS.

PLATE XVII.—Smith Falls made by Lower Selinsgrove Limestone in South Branch of Potomac River west of Petersburg. Right middle is Knobly Mountain. Right rear is New Creek Mountain. Left rear is Chimney Rock of North Fork Mountain. In extreme background the Allegheny Front is visible through North Fork Gap.

The **Lower Selinsgrove Limestone**, as above classified, is well exposed at numerous localities in both counties, and it may also be studied to advantage at Twenty-first Bridge, Allegany County, Maryland, only about one mile northeast of Keyser. Here the Baltimore and Ohio Railroad crosses North Branch of Potomac River in an approximately north and south direction, and just north of the river makes a deep cut several hundred feet long. The Western Maryland Railway, built along the north side of the river, crosses the Baltimore and Ohio just north of the river bridge, its course being northeast and southwest with an elevated crossing, and just northeast of the crossing it makes a cut along the approximate strike of the Selinsgrove Limestone. A short distance southeast of the crossing nearly the full thickness of the Oriskany Sandstone is visible in the river bluff.

Starting at the northern end of the Baltimore and Ohio cut, the following section was measured by traversing southward nearly to the railroad crossing and then turning southeastward with the rising strata to the Oriskany exposure. The shales through the northern half of the cut are very much distorted and the interval between the Selinsgrove Limestone and the Oriskany Sandstone is concealed except for fragmentary exposures of shale, so that precision of measurement can not be claimed and the section may therefore be in error by two hundred feet or more in its total, but the succession, at least, is well exhibited:

Twenty-first Bridge Section.

	Thickness. Feet.	Total. Feet.
Hamilton Series (302')		
1. Shale, greenish-gray, sandy, weathering reddish-brown	34	34
2. Shale, dark, fissile, with nodules of fossiliferous limestone (collection from nodules)	189	223
3. Shale, greenish-gray, sandy, weathering reddish-brown	113	336
Marcellus Series (571')		
4. Shale, black, fissile, with nodules of limestone	316	652
5. Limestone, **Lower Selinsgrove**, nodules at top, with much black and gray shale; more massive, hard, black and somewhat cherty at base; abundant fossils (collection across face of outcrop)	55	707
6. Shale, **Selinsgrove**, black, fissile, mostly concealed	200	907
Oriskany Sandstone (100')		
7. Sandstone, **Oriskany**, with **Spirifer**, etc., visible	100	1007

The above locality has been studied by members of the Maryland Survey, no detailed measurement being made except at another cut southwest of the crossing, but there is a statement (Middle Devonian Volume, page 53) that the limestone is 8 feet thick, which differs materially from the figure of 55 feet recorded above. It is quite true that the main bedded deposit of limestone is much less than 55 feet but above it there comes in a concretionary zone that is evidently a part of the calcareous stage and this has been included under the Selinsgrove. In a collection made by the writer across this 55 feet, Dr. Tilton, as recorded in Chapter XXI, reports many specimens of **Liorynchus limitare,** which the Maryland Survey does not record as occurring anywhere in the lower calcareous beds correlated as Onondaga by that organization. The writer would hesitate much to advance an opinion on the strength of one locality but another section, measured in a steep bluff just south of the Baltimore and Ohio Railroad station at Petersburg, Grant County, and arranged in descending order, gives the following results:

Petersburg Section.

		Thickness. Feet.	Total. Feet.
Marcellus Series (135′)			
1. Concealed, with river boulders		15	15
2. Shale, brown		10	25
3. Shale, black, fissile, typical Marcellus		70	95
4. Limestone, gray, with fossils, corals, etc. 1½′			
5. Shale, black, fissile 3½			
6. Limestone, dark-gray, hard 1½			
7. Shale, black, with limestone nodules 18½	**Lower Selinsgrove Limestone**	40	135
8. Limestone, dark, shaly 1			
9. Shale, black, with large "turtleback" concretions of limestone, to road 14			

At this locality the Oriskany Sandstone is not exposed but in the neighborhood of Petersburg it may be seen at several points, coming only 25 to 50 feet below the limestone beds and as there is no other limestone of any consequence in the black shales, other than the two benches of the Lower Selinsgrove, the identification of the calcareous beds is not subject to much doubt. Here a collection was made by Scheffel and Price from Nos. 4-9, inclusive, of section, and Dr. Prouty, who examined these fossils, reports **Liorynchus limitare** in the shaly members, as recorded in Chapter XXI.

The evidence at these two widely separated points, secured by two sets of observers, presents two alternative conclusions, one of which is that all the strata between the Hamilton Shale and the Oriskany Sandstone in the Potomac region should be definitely correlated with the Marcellus; and the other of which is that **Liorynchus limitare** must be discarded as a reliable diagnostic fossil of the Marcellus if these lower beds are true Onondaga.

In addition to the sections at Twenty-first Bridge, Ridgeville, Claysville, Maysville, and Petersburg, several short measurements and details of the Lower Selinsgrove Limestone and attendant shales will now be given.

Starting in Mineral County the following approximate measurement, arranged in descending order, was made on the hill road east of North Branch of Potomac River, 0.4 mile southeast of Twenty-first Bridge:

	Feet.
1. Shale, black, fissile, typical Marcellus	400
2. Limestone, dark, shaly, siliceous, and fossiliferous, Lower Selinsgrove	50
3. Dark shale and concealed, Selinsgrove Shale	100
4. Sandstone, Oriskany	.....

At the above locality the dip of the Oriskany is 80° so that the beds above it are exposed in succession along a comparatively short stretch of road. Here a collection was made by Scheffel and Price in the Lower Selinsgrove Limestone and in some of the shaly interlaminated beds, and also another in the black shales above the limestone, the identifications of which by Dr. Prouty will be found in Chapter XXI.

The following measurement, in descending order, was made across steeply dipping beds on a branch of Patterson Creek just east of the extreme southern end of Patterson Creek Ridge, 1.5 miles northeast of Alaska:

	Feet.
1. Shale, black, fissile, typical Marcellus, visible	50
2. Limestone, dark, shaly, Lower Selinsgrove	10
3. Concealed, with black shale, Selinsgrove	106
4. Sandstone, massive, Oriskany	.....

At the mouth of Mill Run, 1.5 miles southwest of Alaska, the Lower Selinsgrove Limestone makes a 5-foot reef in Patterson Creek, being dark and siliceous and dipping at a sharp angle.

On Tanners Run of Patterson Creek just northwest of Knobly the limestone is visible in the public road that goes through a gap in Knobly Mountain, being 25 feet thick, dark, shaly, and fossiliferous.

On the Northwestern Pike, 1.8 miles southeast of Burlington, the Lower Selinsgrove is 5 feet thick, dark, fossiliferous, and bedded in gray shale. Slightly to the eastward the top of the Oriskany is visible in the road. At this locality a collection was made by Scheffel and Price, the identifications from which by Dr. Prouty appear in Chapter XXI.

Farther west, along the road which skirts the eastern base of Knobly Mountain, there is a good exposure of the Lower Selinsgrove on the head of Cabin Run, 0.3 mile northeast of Rodgers School. Here it is 10 feet thick, dark, shaly, and fossiliferous. A collection was made at this locality by Scheffel and Price, the identifications by Dr. Prouty being published in Chapter XXI.

The exposure at Ridgeville along the foot of the same mountain has already been published in the Ridgeville Section, page 138. Collections from three zones at this locality by Scheffel and Price and identified by Dr. Prouty will be published in Chapter XXI, together with descriptive data.

At the foot of the same mountain farther south the following estimated section is visible on Mikes Run of Patterson Creek, 1 mile west of Mikes Run School:

	Feet.
1. Shale, black, typical Marcellus	.....
2. Limestone, black, shaly, **Lower Selinsgrove**	5
3. Concealed, with black shale	50
4. Sandstone, massive, **Oriskany**	.....

Farther west there are some exposures in the New Creek Valley. On the east side of this creek about opposite the mouth of Parr Spring Run, 2 miles southwest of Keyser, it is 10 feet thick, black and shaly.

At the foot of the bluff just west of New Creek village the following estimate of thicknesses was made:

	Feet.
1. Shale, dark, typical Marcellus	.....
2. Limestone, dark, shaly, fossiliferous, **Lower Selinsgrove**	5
3. Shale, black, fissile, **Selinsgrove**	30
4. Sandstone, massive, **Oriskany**	.....

At this locality a collection from the Selinsgrove Limestone was made by Scheffel and Price, the identifications from which by Dr. Prouty will be found in Chapter XXI.

In a steep bluff just south of a private road west of New Creek and 1.3 miles southwest of Claysville, the following section was estimated:

	Feet.
1. Shale, black, fissile, typical Marcellus	.....
2. Limestone, dark, shaly, Lower Selinsgrove	5
3. Shale, black, Selinsgrove	50
4. Sandstone, massive, fossiliferous, Oriskany	50

Taking up the occurrence of the Lower Selinsgrove Limestone in Grant County and starting in the Patterson Creek Valley, it is visible along the public road 1.1 miles northeast of Medley, being 5 feet thick, dark, and bedded in black shale.

On the extreme head of Patterson Creek the following estimated section was made along the public road at the foot of Patterson Creek Mountain, 0.4 mile east of Frye School and 1.4 miles east of Old Arthur:

	Feet.
1. Limestone, black, Lower Selinsgrove, visible	10
2. Shale, black	50
3. Limestone, dark, shaly, Lower Selinsgrove	10
4. Shale, black, Selinsgrove	20
5. Sandstone, Oriskany	.....

At the above locality there are two distinct benches of the limestone, a feature that is common in Grant County.

Farther south on a branch of Lunice Creek the following estimate of thicknesses was made at the sharp turn of a private road just north of the Grant-Milroy District Line, 2.7 miles northeast of Petersburg and 1.2 miles southwest of Charles Knob:

	Feet.
1. Shale, black, Marcellus type	.....
2. Limestone, dark, shaly, fossiliferous, Lower Selinsgrove	15
3. Shale, black, Selinsgrove	50
4. Sandstone, massive, Oriskany	.....

At this locality a collection was made by Scheffel and Price described as being in 45 feet of shale coming just above the Lower Selinsgrove Limestone and therefore being in No. 1 of section. The identifications, as made by Dr. Prouty, will be found in Chapter XXI.

In a ravine off the same private road 1.2 miles northeast of Petersburg, the following estimate was made, descending:

	Feet.
1. Shale, black, Marcellus	.....
2. Limestone, dark, shaly, Lower Selinsgrove	25
3. Shale, black, and concealed	50
4. Limestone, dark, Lower Selinsgrove, thickness concealed	.....

Along the same private road 0.7 mile north of the mouth of Lunice Creek, the following section was measured, descending:

	Feet.
1. Shale, black	15
2. Limestone, dark, hard, **Lower Selinsgrove**	15
3. Shale, black	35
4. Limestone, dark, hard, **Lower Selinsgrove**	15

At the above locality the two benches of the limestone are again visible. Tracing the measures southward to the mouth of Lunice Creek, the Oriskany Sandstone is exposed in regular order, confirming the identifications, and a little farther east, along the Moorefield road lying north of South Branch of Potomac and 1.2 miles northeast of Petersburg, this relationship is exhibited as follows:

	Feet.
1. Shale, dark, fissile	.....
2. Limestone, dark, shaly, **Lower Selinsgrove**	20
3. Shale, black, limy, **Selinsgrove**	30
4. Sandstone, **Oriskany**	.....

The exposure in the bluff just south of Petersburg has already been detailed in the Petersburg Section, page 322. On the road leading northward from Petersburg up Lunice Creek the limestone is visible at several points, being 10 feet thick and black at a point 1 mile northwest of Petersburg.

The outcrop at Maysville, which is one of its best exposures in the two counties, both benches being represented, has been detailed in the Maysville Section, page 176. Collections were made here by Scheffel and Price, as described in Chapter XXI. It is visible again 0.1 mile west of Brick Church on Lunice Creek west of Cosner Gap, being 10 feet thick, dark, shaly, and fossiliferous, and apparently resting almost upon the Oriskany.

Along the road which follows the eastern base of Knobly Mountain, it is exposed 1.6 miles north of Corners, being 10 feet thick, black and shaly.

On Jordan Run 1 mile above its junction with North Fork of South Branch, the following estimate of thicknesses was made:

	Feet.
1. Shale, black	.....
2. Limestone, dark, shaly, **Lower Selinsgrove**	10
3. Concealed	50
4. Sandstone, **Oriskany**	150

Along the north side of South Branch of Potomac the limestone is exposed at a locality one-half mile northeast of

Royal Glen Mill, being dark, hard, and 10 feet of it being visible.

At Smith Falls, 1.5 miles west of Petersburg, it makes a reef across South Branch of Potomac, there being a northwestern dip of 17°, contrary to the direction of the stream so that a small cataract, or riffle, is formed. At this point, however, the major portion of the limestone outcrops in the bluff above water-level, the following section being visible, descending:

	Feet.
1. Shale, black, fissile, typical Marcellus	.....
2. Limestone, black, with shaly streaks, Lower Selinsgrove, visible in bluff and riffle	20

Eastward from the falls the dip is much less rapid so that the exposure of the limestone continues in the river bluff for some distance. A collection was made by Scheffel and Price from a locality described as being 100 to 300 feet east of the falls, the identifications of which by Dr. Prouty will be found in Chapter XXI.

In the region south and southeast of South Branch of Potomac River there are several exposures of the limestone. On North Mill Creek, 0.6 mile northeast of Pansy, it is visible along the road, being dark and hard and 10 feet of it being exposed above drainage.

On a branch of Mill Creek, 0.5 mile east of Hiser, there is a bed of limestone 25 feet thick, black, and shaly, outcropping along the road. This exposure is at the Lower Selinsgrove horizon and appears to be the upper bench.

The limestone is again visible along a mountain road, 0.6 mile south of Masonville, being dark, shaly, and 20 feet thick, with an elevation of 1,450′ B.

ECONOMIC ASPECTS, MARCELLUS SERIES.

Apparently the most valuable economic feature of the Marcellus Series is its capacity for making agricultural soil, this being especially true of the calcareous beds in the lower part of the group. The black, fissile shale of the upper part, however, is not very productive along the line of its outcrop where deep weathering has not occurred, there being many barren spots where grass and crops do not grow to advantage. After it has been washed into the creek and river valleys and mixed with other disintegrated shales and has become thoroughly weathered, it makes a wonderfully fertile soil, being well adapted both for grazing and agriculture. A sample (No. 551R) was collected from the unweathered

black shale above the Lower Selinsgrove Limestone on the land of Ola Smith, at Smith Falls, 1.5 miles west of Petersburg, Grant County, from which the following analysis was made by Mr. Kaplan:

	Per cent.
Silica (SiO_2)	55.80
Ferric Iron (Fe_2O_3)	23.30
Alumina (Al_2O_3)	9.92
Lime (CaO)	0.77
Magnesia (MgO)	0.45
Phosphoric Acid (P_2O_5)	0.03
Moisture	0.74
Loss on Ignition	9.36
Total	100.37

The above sample shows a higher percentage of ferric iron and less alumina than the Marcellus Shale generally appears to contain, as its argillaceous character is usually quite apparent from the way it weathers into mud. The only physical feature indicating the presence of iron is the rusty brown, metallic scale that often occurs on weathered fragments of the shale, although the iron that is native to the Oriskany Sandstone often leaches out and is absorbed by the Marcellus in localities like the eastern base of Knobly Mountain where the steep pitch of the sandstone is great enough to raise extensive portions of its mass above the general level of the Marcellus so that the soft, ocherous material can be carried by gravity from the Oriskany to the Marcellus. Some instances of this migration of ore will be detailed in Chapter XIX under the subject of "Iron Ore."

The Marcellus Shale contains a considerable amount of carbonaceous matter that is no doubt reflected to some extent in the ignition loss of 9.36 per cent. This would be a disadvantage in using the shale for brick, although a considerable shrinkage in the burned product is always expected and provision is made for it. Drifts into this black shale are often made in the expectation of finding coal by prospectors who are poorly informed on the geologic occurrence of this fuel, but they always result in failure, as the carbonaceous matter is never segregated into seams such as are found in the coal measures. In Mineral County prospecting was once done on a branch of Patterson Creek 1.6 miles southeast of Burlington, in the belief that the Marcellus at that locality contained graphite in commercial quantity, but an examination of the prospect does not show any segregation of carbonaceous matter from which graphite might

have been produced, and other essential conditions for its formation are also lacking.

In some regions of the Appalachian Province the black Marcellus, or Devonian, Shale, as it is often called, contains a considerable quantity of bituminous matter so that it is regarded as an oil shale from which petroleum and allied products may be eventually distilled. In Mineral and Grant Counties it shows no visible evidence of petroleum and it is believed that the heat and pressure developed during the formation of the Allegheny Mountains has already volatilized the major portion of these products, leaving only the basic carbon residue.

The economic aspects of the Lower Selinsgrove Limestone will be discussed in Chapter XVIII under the subject of "Limestone."

CHAPTER XIII.

STRATIGRAPHY---LOWER DEVONIAN ROCKS.

INTRODUCTION.

As previously stated the Lower Devonian Rocks include the Oriskany Sandstone and Helderberg Limestone, together comprising 400 to 800 feet of strata. In the early study of the Paleozoic beds of North America these two formations were classed as Silurian but in more recent years a careful comparison with the European and English equivalents by leading geologists has led to the discovery of a time hiatus at the base of the Helderberg Limestone, as now limited, which it is believed represents the dividing line between Devonian and Silurian, although full agreement on this point is not yet conceded by all. This very interesting problem has been ably discussed by Swartz, Schuchert, and Prosser in the volume on the Lower Devonian of Maryland, issued by the Maryland Geological Survey. In the present Report, in which space must be given to the rocks of other periods as well as to much economic data, the Devonian-Silurian contact plane, as interpreted by Maryland, has been adopted. Unfortunately the volume on the Silurian of that State, which has been in preparation for several years and which should shed further light on this question, came off the press too late for detailed comparisons.

ORISKANY SANDSTONE.

GENERAL ACCOUNT, ORISKANY SANDSTONE.

The Oriskany Sandstone, comprising the siliceous beds lying below the shales classed as Marcellus in this Report and being just above the Helderberg Limestone, is a generally massive deposit of mixed arenaceous and calcareous material, varying in thickness from 100 to 200 feet. As a usual rule the upper three-fourths of this formation is a coarse, yellowish-brown sandstone, containing small, angular,

elongated grains of quartz, somewhat similar in size to grains of wheat or rice. In this portion, also, bands of reddish ocher or soft iron ore, 0′ 6″ to 3′ 0″ thick, are not infrequent. The lower portion of the group is a bed of impure chert, yellowish-gray in color, but usually quite soft and porous with a great resemblance to blast-furnace slag, this condition being evidently caused by the leaching out of its calcareous content without a subsequent replacement of silica. It has a high cementing value and makes an almost ideal material for surfacing roads where light traffic is handled, as it can be shoveled out like sand at many weathered outcrops. At some localities this chert is missing almost entirely and in such cases the overlying sandstone is apt to be quite calcareous so that its junction with the Helderberg is not easily recognized.

The stratigraphic associations of the Oriskany are such that it has great individuality. Below it there is a great mass of limestone, 1,000 to 1,400 feet thick, followed by other strata of mixed limy, shaly, or weakly arenaceous characteristics for another 1,000 feet, until the white Medina Sandstone of a purely siliceous and littoral type appears. Above it there occur nearly 10,000 feet of rocks in which shale is the predominating feature up to the heavy sandstones of the Pocono Series, although there are frequent flagstones and small conglomerates found in the Chemung. It is thus seen that the Oriskany represents a depositional phase in which shore-line or littoral conditions must have suddenly occurred after a long lapse of quiet and comparatively deep water, and must have suddenly stopped again for another extremely long time.

In Chapter V the Oriskany is recorded in the Section for Claysville as 50′+, in that for Falls as 75′+, in that for Limestone Run as 194′, in that for Maysville as 215 feet, and in that for Potomac as uncertain on account of concealment. It is abundantly fossiliferous at nearly all outcrops.

TOPOGRAPHIC EXPRESSION, ORISKANY SANDSTONE.

The Oriskany Sandstone, taken in conjunction with the chert at its base and also with the New Scotland Chert at the top of the Helderberg, is responsible for many of the narrow and ragged ridge lines that prevail in the two counties. Its most conspicuous outcrop is along the eastern side of Knobly Mountain where its dip is such that it often forms almost the entire slope of the mountain and is responsible for the sharp knobs from which the name is derived, there

being deep gaps between, in which rapid weathering down into the limestones has occurred. At the western bases of Patterson Creek Mountain and Elkhorn Ridge it is also prominent but is much in the nature of a buttress on these slopes as it soon shoots into the air, and the same statement is generally true of the western bases of New Creek and North Fork Mountains. At the extreme southern end of Patterson Creek Mountain and at the northern end of Cave Mountain it forms a sort of shield that greatly protects the underlying calcerous rocks. In the Smokehole Settlement of Grant County it is also influential in preserving the rugged, broken masses that form the mountains along South Branch.

AREAL EXTENT, ORISKANY SANDSTONE.

In Mineral County, as shown by Map II, the Oriskany Sandstone makes an almost unbroken outcrop around the base of Patterson Creek Ridge but goes under drainage along the axis of the Tussey Mountain Anticline about one mile northeast of Alaska, where the ridge also disappears. East of Patterson Creek Ridge it is found along the Martin Mountain Anticline. Farther south its top is just barely above the surface where the Northwestern Pike crosses the Beaver Run Anticline southeast of Burlington, and it makes another larger outcrop along the same anticline northeast of Russelldale and also covers most of the northern end of the main Patterson Creek Mountain southwest of Russelldale. The outcrop which forms the western base of this mountain thence extends southwestward to the Grant County Line. West of Patterson Creek there is a small strip of Oriskany along the axis of the Evitts Mountain Anticline, extending from North Branch of Potomac southward for two miles. It then goes under drainage along the Bedford Syncline and associated folds but comes out again at the eastern base of Knobly Mountain and forms a continuous outcrop from Cumberland southwestward to the Grant County Line. West of Knobly Mountain it occurs along the Rawlings Syncline and at the northern end of the Noswad Anticline, and also is quite prominent along the Noswad Syncline from Rock Hill to the northern end of New Creek Mountain. Between New Creek Mountain and New Creek there is a long outcrop extending from Keyser to a locality 1.2 miles southwest of Claysville where it passes to the western side of the creek and remains about one-fourth mile west of it to the Grant County Line. On the western side of New Creek, also, there is an outcrop in the eastern end of Keyser and this is found

again on the Maryland side of the Potomac in the top of Queens Point east of McCool. Just west of New Creek village it is visible again in the bluffs, giving rise to the possibility that there may be a buried anticline all along the western side of New Creek from Keyser to New Creek and perhaps somewhat farther.

In Grant County, as shown by Map IV, there is a long outcrop of Oriskany lying at the western base of Patterson Creek Mountain and extending from the Mineral County Line southwestward to South Branch of Potomac east of Petersburg where it is prominent on either side of the gap made by that stream through the mountain. East of Medley there is an offshoot west of the general alignment of this outcrop, being caused by the presence of a short anticline, and at the southern end of the mountain next to South Branch there are several fingers or ridges of Oriskany caused by the multiple folds along either flank of the Patterson Creek Mountain Anticline in the region where it begins to subside. South of South Branch along the same anticline the Oriskany covers the comparatively low ridge extending from South Branch of Potomac nearly to Hiser, its outcrop being faulted in the gap of the river. Farther south there is a long outcrop on the western flank of the Elkhorn Mountain Anticline, reaching from Hardy County entirely across Grant to Pendleton and east of this anticline it is found again along the length of the Deep Spring Syncline in the county.

West of the Bedford Syncline, under which it is deeply buried in all the region north of South Branch, the Oriskany appears again at the eastern base of Knobly Mountain and follows along it southwestward to North Fork of South Branch. Just south of North Fork it makes a great escarpment and then extends southward along the western side of South Branch with an outcrop that is wide at the northern end but gradually narrows until it apparently discontinues in the bluffs about opposite Shoock Gap, to recur in a short strip about 1½ miles in length immediately north of the Pendleton County Line. On the eastern side of South Branch in the same part of the county it covers almost the entire northern end of Cave Mountain, with anticlinal fingers extending in some cases north of South Branch, and with a faulted outcrop west of the Peacock Cave Anticline, the break being distinctly visible on South Branch between this anticline and the mouth of North Fork. Farther south the outcrop veers to the eastern base of Cave Mountain and so continues to the Pendleton County Line. On the western

side of the Cave Mountain Anticline there are three small isolated outcrops along the axis of the Blue Rock Syncline, from Blue Rock southwestward to Bulls Head.

In that portion of Grant County west of the Wills Mountain Anticline, or west of New Creek and North Fork Mountains, and starting at the Mineral County Line, the Oriskany is found on the western sides of Kittlelick Ridge and Walker Ridge, but along the latter, west and southwest of Greenland, minor folds appear so that the outcrop is more complicated, being in part covered by Marcellus along the syncline northeast of Excelsior School. Just south of this school, however, these small folds die out and the outcrop then follows the western base of New Creek Mountain by way of Brick Church and Streby to the head of Jordan Run and thence down the eastern side of this stream to a point about two miles south of Jordan Run Post-office where the Hopeville Anticline and Hopeville Syncline interrupt the general slope and the outcrop widens to cover them both in the vicinity of Hopeville Gap where the Oriskany makes enormous cliffs both along the gorge of Jordan Run and in the passage through the Gap. In the region southwestward by way of Hopeville to the Pendleton County Line this sandstone generally covers the two folds mentioned, being partly on the eastern and partly on the western side of North Fork where several short ridges are made by it.

CONTACTS, ORISKANY SANDSTONE.

The contact of the Oriskany Sandstone with the Marcellus above it has already been discussed in the description of the latter series, page 317, an unconformity being indicated because of the absence of some of the New York beds. At its base the yellowish-gray Shriver Chert of the Oriskany with a slight unconformity rests upon the light-gray or white New Scotland Chert of the Helderberg, as the Becraft Limestone is not present in the two counties. When these two cherty members, or even one of them, is present, the approximate contact may usually be followed by eye without difficulty. When both are absent, however, there is often a baffling interlamination of beds of sandstone and limestone on account of which the contact may be mistaken by as much as 25 to 50 feet. To the writer there also appears to be an unusual intermingling of Oriskany and Helderberg fossils in such cases, although collections were not made for the determination of this point.

FOSSIL LIFE, ORISKANY SANDSTONE.

The Oriskany Sandstone is abundantly fossiliferous throughout, both in the sandy member at the top and in the cherty phase at the base. Its guide fossil, Spirifer arenosus, is reported by Dr. Tilton from a single specimen collected by the writer at the top of the Queens Point cliff just west of McCool, Allegany County, Maryland, and just north of Keyser. In addition to this pocket specimen, another small collection was made by the writer near Williamsport, Grant County, the identifications from which by Dr. Tilton are published in Chapter XXI. Eight collections, all from the Ridgeley Sandstone Member, were made by Scheffel and Price, the identifications of which by Dr. Prouty will be found in Chapter XXI.

The following is a summarized list of all fossils identified from the Oriskany by Drs. Tilton and Prouty in the two counties, one collection from Allegany County, Maryland, being included:

Spirifer arenosus Hall
Spirifer intermedius Hall
Spirifer murchisoni Castelnau
Rensselaeria cf. cayuga Hall and Clarke
Rensselaeria sp.
Rensselaeria (Beachia) suessana Hall
Rensselaeria close to circularis Schuchert
Rensselaeria ovoides Easton
Stropheodonta (Leptostrophia) magnifica Hall
Stropheodonta (Leptostrophia) cf. magnifica Hall
Rhipidomella cf. musculosa Hall
Platyceras sp. large form
Actinopteria sp.
Hipparionyx proximus Vanuxem
Algae ?
Orbiculoidea sp.
Anoplotheca sp.
Anoplotheca fimbriata Hall
Streptelasma ? sp.
Chonostrophia complanata Hall
Tentaculites cf. elongatus Hall
Platyceras reflexum Hall
Platyceras sp.
Platyceras gebhardi Conrad
Meristella sp.
Crinoid sp.
Leptaena rhomboidalis Wilckens.

SUBDIVISIONS, ORISKANY SANDSTONE.

The Maryland Geological Survey (Lower Devonian, pages 91-92) has subdivided the Oriskany of that State into two members, the **Ridgeley Sandstone** at the top, comprising two-thirds or three-fourths of the formation, and the **Shriver Chert,** at the base, accounting for the remainder. This classification has close application to Mineral and Grant Counties and is herein employed.

Illustrative of the occurrence and relationship of these two members, Chas. Schuchert and R. B. Rowe (Lower Devonian, page 181) report the following section, measured in Mineral County, West Virginia, in a cut of the Baltimore

and Ohio Railroad along North Branch of Potomac just south of Twenty-first Bridge, or about one mile northeast of Keyser:

ORISKANY FORMATION.

Ridgeley Sandstone Member.	Vertical thickness. Feet.	Total vertical thickness. Feet.
Heavy-bedded arenaceous limestone, gradually changing downward into a black chert or siliceous shale. In the lowest beds are found **Spirifer cumberlandiae, S. concinnoideus,** and **Eatonia sinuata.** Fossils, however, are rare until 100 feet above the base of this division, where the characterizing Hipparionyx fauna attains greater individual and specific representation, culminating in the upper 100 feet.....	258.0	258.0
Shriver Chert Member.		
Bedded and nodular chert and siliceous shale, with a sparse fauna distinct from the Hipparionyx fauna above and from the Helderbergian below. Near the base are found **Anoplotheca flabellites** (aa), **Stropheodonta arctimuscula** (r), and Ostracoda. Just below the middle occur **Anoplotheca flabellites** (c), **Spirifer tribulis** (c), **S. paucicostatus, Beachia suessana** var. **immatura, Anoplia nucleata, Pholidops multilamellosa, Tentaculites aculus** and **Diaphorostoma desmatum.** Near the top is an abundance of ostracoda and some **Chonetes hudsonicus**....	90.	348.0

The section as above measured records a greater thickness of the Oriskany members than the writer was able to discover in the two counties, no check measurement having been made at this particular exposure. A total of only 194 feet was found at the Limestone Run Section measured just east of Keyser and about one mile southwest of Twenty-first Bridge; and at Maysville, Grant County, as indicated in the section for that point, there was a total of 215 feet. It would therefore appear that the measurement of Schuchert and Rowe represents the maximum of these beds to be found at any point in the two counties. In the Ridgeley Sandstone the fossils found only in the lower portion are named in detail but in the Shriver Chert a more complete list is given and this will be of special interest, since the collections made for the present Report are deficient on that member.

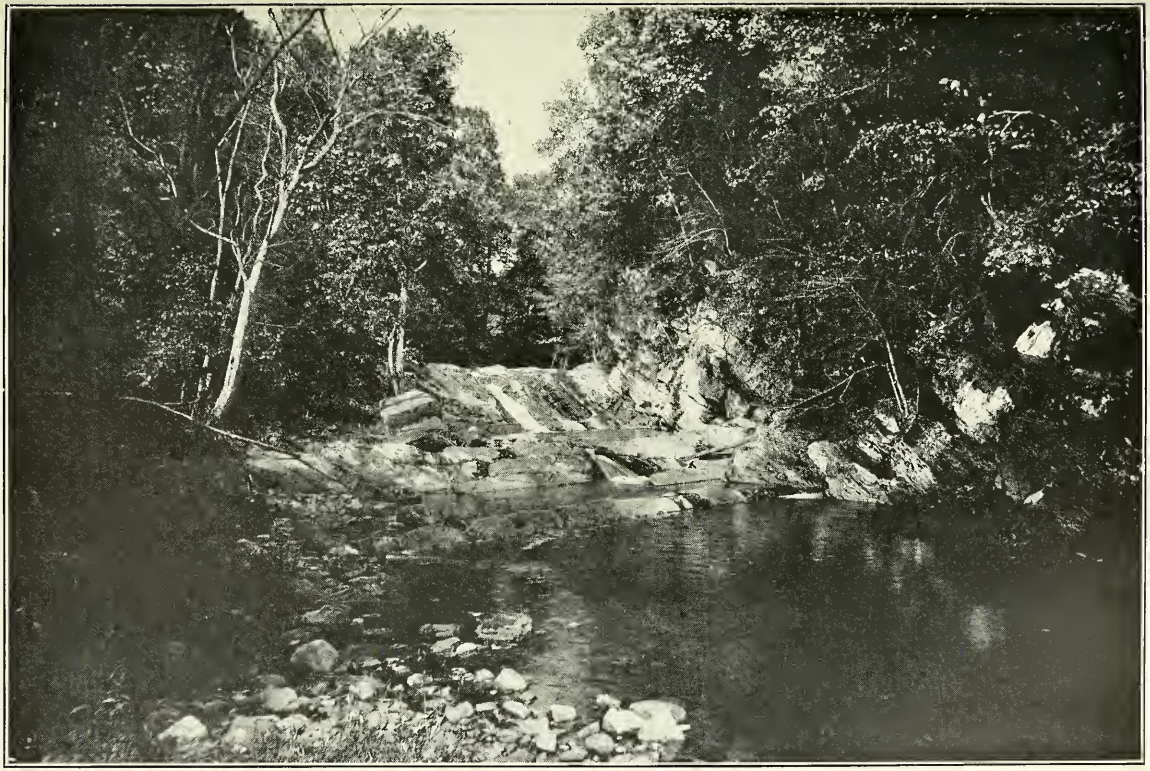

Photo by E. E. HARRIS.

PLATE XVIII.—Outcrop of Oriskany Sandstone in North Fork of Patterson Creek just northwest of Falls, Grant County. See Falls Section.

Ridgeley Sandstone.

The **Ridgeley Sandstone** in Mineral and Grant Counties is a coarse, yellowish-brown, massive bed, usually quite porous and loosely cemented so that it often weathers to beds of sand at localities where highways pass over its upper surface. It contains a considerable amount of iron oxide which at some points is found scattered through the mass and at others appears in the form of stratified streaks of soft, ocherous material which weathers much more rapidly than the matrix. A discussion of the iron content of this member will be found in Chapter XIX, under the subject of "Iron Ore." In thickness the Ridgeley Sandstone varies from 50 to 150 feet in the two counties, being not more than 100 feet at most localities. Its composition varies greatly, its usual appearance being that of a coarse sandstone with occasional small, elongated quartz pebbles, but at frequent points it is quite calcareous. Exposures of this member in the two counties are too numerous to be named in detail. Its entire cross-section may be observed at almost any gap where transverse drainage cuts across its outcrop, there being literally hundreds of such points.

So far as known little quarrying has been done in the Ridgeley Sandstone in either county, although it has been used extensively for building stone at Cumberland. At Antioch, Mineral County, the old Sylvester Mott homestead was built from it about the year 1840, according to Mr. D. G. Martin, its present owner. One end of this building is still in a fair state of preservation but a defective foundation at the other end has caused some breakage of the stone. The Nathaniel Kuykendall house, located on the Northwestern Pike between Ridgeville and Markwood, was built about the same time, according to Mr. Martin, and now shows little effect of wear. There are many localities where this rock could be quarried easily and cheaply, and if points be selected where the sand grains are well cemented by iron or lime, stone of fairly durable character for basements or masonry structures could be obtained.

Shriver Chert.

The **Shriver Chert,** coming just below the Ridgeley Sandstone and being the basal member of the Oriskany, is a yellowish-gray, spongy material, much resembling blast-furnace slag in appearance. Contrary to the usual nature of a chert it is often quite soft, weathering partly into irregular chunks with crumbling surfaces and finally into small particles like sand. That it contains a considerable amount

of lime is evident, however, from the fact that it cements readily when used as road material and subjected to the crushing effect of traffic. Its thickness varies from 25 to 75 feet, being 65 feet in the Limestone Run Section and 50 feet in that for Maysville. This member is fossiliferous but no collections were made from it by the West Virginia Geological Survey. On the north side of the Potomac its fauna is reported in detail at several localities by the Maryland Survey in the volume on Lower Devonian. One of these collections was made in Mineral County near Twenty-first Bridge, as already published, page 336, and doubtless represents the two counties fairly well.

In many localities the Shriver Chert has been used for surfacing roads, for which it is admirably adapted. In general practice some convenient point where the chert is much weathered is selected and the material is shoveled into trucks or wagons, often without the necessity of blasting, as the locality is usually abandoned and another one used when excavation has reached the unweathered material. At some points, however, more extensive digging has been done. On the south side of North Branch of Potomac, one-half mile southeast of Keyser and just west of Limestone Run, it has been worked at the **John W. Keys Quarry**, there being about 50 feet of it exposed. On the Maryland side of the Potomac, just north of Potomac Station there is a considerable quarry, and another is located along the highway on the north side of Fort Hill, 1.3 miles southwest of Rawlings. In Grant County there is a large excavation on the north side of North Fork of Patterson Creek, 0.7 mile west of Greenland, and another on the land of **Simon Idleman** on the north side of Lunice Creek just west of Brick Church and only a short distance west of Cosner Gap.

ECONOMIC ASPECTS, ORISKANY SANDSTONE.

As already stated the Ridgeley Sandstone member of the Oriskany has been used to some extent for building but full advantage of its value has not been taken in view of the fact that it is often the only massive sandstone for many miles in the region of its outcrops. If care is used in selecting quarry sites a large amount of durable stone could be obtained from it. The Shriver Chert, also, as has been indicated, has an economic value, being suited for light traffic road material that can often be excavated and placed for a fraction of the cost of quarrying harder stone, while its cementing quality causes it to compact under traffic. This chert, in con-

junction with the New Scotland below it, also weathers into a peculiar soil that has been found to be ideal for fruit raising, there being extensive orchards along many of its outcrops. It is frequently necessary to blast out holes in which to put the trees but when finally placed their growth is rapid.

HELDERBERG LIMESTONE.

GENERAL ACCOUNT, HELDERBERG LIMESTONE.

The Helderberg Limestone, coming just below the Oriskany Sandstone and being the basal group of the Devonian Rocks, consists of upper cherty strata followed by heavy beds of limestone. The chert is grayish-white, fossiliferous, and quite hard, but is flaggy and interstratified to some extent with softer bands of limestone. The limestone members below the chert are in general massive, gray, and quite hard, being characterized by numerous fossils among which coral reefs are often conspicuous. In thickness the group varies from 300 to 600 feet in the two counties. In the Cedar Cliff Section, page 134, it is 469 feet; in that for Falls, page 174, the measurement totals 976 feet but the exposures are not good and if better angular observations could be secured and its lower contact determined with more certainty its computed thickness would probably be less than that figure; in the Limestone Run Section, page 139, measured near Keyser, it is 356 feet. In the Potomac Section, page 136, its basal contact is plain but its upper boundary with the Oriskany is concealed. At this point there is about 50 feet of Shriver Chert visible and if a total of 75 feet be allowed for this member there would be left 475 feet of thickness for the Helderberg. At Maysville, Grant County, the basal contact was concealed but if the covered portion be assumed as Helderberg the total thickness would be 420 feet.

In time relationship the Helderberg was correlated as Silurian by early students of North American geology but in more recent years comparison with its apparent European equivalents has caused it to be considered as Devonian, although the proper limits of its base are still in controversy as will be discussed under the subject of "Contacts."

TOPOGRAPHIC EXPRESSION, HELDERBERG LIMESTONE.

The Helderberg Limestone of the two counties is influenced greatly by stratigraphic associations and therefore does not fully reveal the topographic forms that it might assume if free from external support. It is seldom, if ever,

found in valleys and does not often occur along mountain summits, although in several instances it is present along the crests of low ridges where it is completely buttressed by the Oriskany Sandstone on either side. In general, however, it occurs along the lower or middle slopes of mountains where the Oriskany is present in the form of a shoulder at the base and more resistant formations like the White Medina form the summits. Patterson Creek Ridge, in northeastern Mineral County, is an instance where it outcrops on the summit and is almost completely surrounded and supported by the Oriskany; while farther south it occurs on the western side of the main ridges of Patterson Creek Mountain and Elkhorn Mountain. In Knobly Mountain, where the rise is westward, the high summits are usually formed by the Oriskany Sandstone group in conjunction with the New Scotland Chert of the Helderberg while the more calcareous members of the Helderberg outcrop in the low gaps or on the northwestern face of the mountain. At many points along North Branch of Potomac River there are almost sheer cliffs of 1,000 to 1,200 feet made by the Helderberg in association with the Silurian limestones below it. On the western flank of the great Wills Mountain Anticline it is found again near the western bases of the New Creek Mountain and North Fork Mountain slopes, but at a few localities like Walker Ridge, where minor structures occur to interrupt the slope, it is cut off from the main mountain by erosional valleys in the Silurian.

AREAL EXTENT, HELDERBERG LIMESTONE.

In Mineral County, as shown by Map II, the Helderberg Limestone makes an isolated outcrop in the summit and at the northern end of Patterson Creek Ridge, being brought above drainage by the Tussey Mountain Anticline; and it also is partly above drainage where the Evitts Mountain Anticline crosses the Potomac. Farther south it does not outcrop again on these two folds but at the northern end of the main body of Patterson Creek Mountain in the vicinity of Russelldale it emerges at the beginning of the Patterson Creek Mountain Anticline and is exposed across its axis southward to the Grant County Line, there being two anticlines and two synclines in this locality, with topographic reflection giving rise to the name of "Twin Mountain," across which there is an almost continuous exposure of the New Scotland Chert member, the lower calcerous beds being visible at some points.

West of the lines of uplift just mentioned the Helderberg lies deeply buried under the Bedford and other synclines

but recurs above drainage in Knobly Mountain, its cherty member usually being found in the high peaks while the calcareous divisions occupy the low gaps and the upper portion of the western slope. Starting at Cumberland this relationship to the topography is sustained without break entirely across the county to the Grant County Line. In the region southwest of Rawlings, however, structural and topographic variations are introduced. Here the axis of the Wills Mountain Anticline lies along the western slope of Knobly Mountain, bringing the Silurian to the surface and dividing the Helderberg outcrop so that the unusual circumstance of two areas of the same formation on one mountain slope is apparently caused. Just to the westward the Rawlings Syncline depresses the structure until it is covered by younger beds but the Helderberg is visible again on either flank of the Noswad Anticline along its short length. It is also present at the northern end of the Noswad Syncline, lying to the westward, but from Rock Hill southwestward the outcrop along this basin is divided by younger beds. Along the Fort Hill Anticline, lying still westward, the Helderberg is exposed at several localities, partly on the flanks, partly on the axis, and partly at river channels cut through the younger rocks, the most southern of these being in the extreme northern end of New Creek Mountain just east of Keyser. In this region between Rawlings and Keyser the complicated structure and irregular topography, both of which are cut by the meanders of North Branch of Potomac, make it difficult to follow descriptions of outcrops so that reference to Map II is advisable for clear understanding.

In the region southwest of Keyser the Helderberg outcrop is mainly on the eastern slope or partly on the summit of New Creek Mountain for the six miles along which it is a comparatively low ridge. Beyond this point, however, the mountain suddenly assumes massive proportions, bringing much older rocks to the surface and the Helderberg is then found on the western slope for a few miles, but about one mile southwest of Claysville the origin of minor folds has pushed it west of New Creek entirely and it so remains to the Grant County Line.

In Grant County, as shown by Map IV, there is a long belt of Helderberg extending from Twin Mountain southwestward along the western flank of Patterson Creek Mountain to the sudden drop in the structure south of Charles Knob where it curls eastward around this promontory to the Hardy County Line. In the gap of the Potomac east of

Petersburg, however, the river has cut entirely through the Helderberg so that it makes a complete outcrop on the summit of the Patterson Creek arch, but is so faulted and partly concealed that its study is difficult. Farther south this arch declines and the limestone is not seen beyond the immediate valley of South Branch,

In southeastern Grant the Helderberg makes a narrow outcrop on the northwestern flank of the Elkhorn Mountain Anticline, there being much older formations along the axis, and on the eastern flank of this fold it occurs again where the rocks pitch southeastward toward the Deep Spring Syncline.

Along the Middle Mountain and Bedford Synclines the Helderberg is far under drainage but from the Mineral County Line southwestward the long outcrop mentioned as occupying a portion of the low gaps and western flank of Knobly Mountain continues to North Fork of South Branch of Potomac in the region west of Corners. Crossing North Fork it then extends southward by way of Shirk Gap to the Pendleton County Line, being partly on the west side and partly on the east side of South Branch in the region south of Shirk Gap and being covered at some points by the Oriskany. In the vicinity of Shirk Gap, also, it extends eastward across South Branch and one very narrow strip then turns northward along the eastern side of a fault which lies between South Branch and the Peacock Cave Anticline, this outcrop being apparently about two miles long; and a wider belt continues eastward by the mouth of Peacock Cave and circling across Cave Mountain and the Cave Mountain Anticline then turns southward along the eastern slope of the mountain and arch and so continues to the Pendleton County Line.

In that portion of the county west of the Wills Mountain Anticline, which nearly coincides with the summits of New Creek Mountain and North Fork Mountain, the Helderberg at the Mineral County Line is found on the eastern side of Walker Ridge and extends southward with this low string of hills, but south of Mountain Valley School it is partly on the western slope and partly on the summit of these hills which gradually become discontinuous, being even replaced by a large sink hole about 1½ miles northward from Greenland. Between Greenland and Scherr there is a full outcrop where a minor anticline crosses North Fork of Patterson Creek. It then follows southward along the eastern flank of an unnamed ridge to Brick Church, crosses Lunice Creek and then practically coincides with a string of low hills to South Fork

of Lunice Creek just east of Streby. From Streby southward these little hills are not fully separated by erosion from the main mass of New Creek Mountain but are reflected in the form of points or shoulders, buttressed on the west by the Oriskany, with the Helderberg occupying their summits or the depressions eastward, this alignment of structure and topography continuing to North Fork of South Branch of Potomac at the mouth of Jordan Run. From Jordan Run southwestward to the Pendleton County Line there is a similar topographic reflection of the combined Oriskany and Helderberg outcrop its position being east of North Branch and slightly up against the general slope of North Fork Mountain.

CONTACTS, HELDERBERG LIMESTONE.

The upper contact of the Helderberg with the Oriskany has already been discussed, page 334, a slight unconformity being indicated due to the absence of the Becraft Limestone. Its lower contact with the Silurian Rocks in North America is a point on which full agreement among geologists has not yet been reached. In early reports the Helderberg and upper limestones of the Silurian were all included under the general title of "Lower Helderberg" but the subsequent discovery that the lower beds only were of Silurian age led to the restriction of the title "Helderberg" to the limestone of Devonian time. The proper basal limit of the Helderberg Limestone, however, is a question that has not been answered to the satisfaction of all. Perhaps the most detailed discussion of this problem is that which appears in the Lower Devonian volume of the Maryland Survey, and as the beds in the western portion of that State are quite similar to those found south of the Potomac in Mineral and Grant Counties, West Virginia, the same criteria should largely apply to the latter area.

In reviewing the work of various authors Dr. Swartz calls attention to the differing beliefs as to the position of the Manlius Limestone of New York, the opinion being held by some that it is Devonian while others place it in the Silurian and correlate with it the Tonoloway Limestone of the Pawpaw-Hancock Folio, No. 179, of the United States Geological Survey. Dr. Swartz himself, however, expresses the belief (pages 104-105) that the Tonoloway may not be represented by any similar unit in New York but concludes that it is probably the same as the Bossardville of Pennsylvania and New Jersey. On a later page (113) he indicates that the Keyser Member (basal Helderberg) is considered equivalent to the combined Manlius, Rondout, and Decker Ferry of New Jersey, and further on (pages 115-117), calls attention to the

views of Ulrich in which it is pointed out that agreement has not yet been reached as to the succession of the latter three units, the opinion of Ulrich being that the descending succession should be Rondout, Decker Ferry?, and Manlius.

In the evident belief that some of these problems still remain unsettled the Maryland Survey employs in part the nomenclature of New York but uses the term "Keyser Member" to include the lower portion of the Helderberg, as will later be shown under the subject of "Subdivisions."

The lower contact assumed for the Helderberg in Mineral and Grant Counties is the zone in which abundant marine fossils, particularly stromatoporoids, suddenly disappear, in making a study of the limestone in descending order; and this division seems to correspond in general with that employed by the Maryland Survey, although that organization reports coral reefs and a few other fossils in portions of the Tonoloway (Bossardville). On the West Virginia side of the Potomac no stromatoporoids were observed in the Bossardville and other fossils are apparently more sparing than in Maryland. In lithologic aspect the contact is marked by more massive limestone in the Helderberg and more flaggy and slightly darker beds in the Bossardville.

FOSSIL LIFE, HELDERBERG LIMESTONE.

The Helderberg Limestone, with all of its subdivisions, is abundantly fossiliferous, its faunule including corals, echinoderms, mollusks, and arthropoda. It has been studied intensively on the northern side of the Potomac by members of the Maryland Survey, collections being reported from numerous localities some of which are in West Virginia. The following composite section, assembled from exposures at several points, is published on pages 89-90 in the Lower Devonian volume on that State and illustrates the typical fossil content, and doubtless applies closely to Mineral and Grant Counties, except that the Becraft Member is not found so far westward:

COMPOSITE SECTION OF THE HELDERBERG FORMATION.

			Feet.	Feet.
Becraft Member. 85 feet.	Cherry Run, West Virginia	Dark blue arenaceous limestone, with lumps of black chert. The fauna is most abundant in the upper half, where **Rensselaeria subglobosa** is the characteristic fossil. .....About	85.0	423.6
		This member is absent west of Hancock. In other eastern sections the thickness may attain to 125 feet.		

			Feet.	Feet.
New Scotland Member 49 feet.	Twenty-first Bridge, West Virginia.	Soft, bluish, argillaceous shales, with some harder layers and occasional manganese-phosphatic nodules. Its faunule includes **Dalmanella planiconvexa, Rhipidomella oblata, Schuchertella woolworthana, Leptaena rhomboidalis, Anoplia helderbergiae, Ambocoelia umbonata?, Spirifer macropleurus, Meristella arcuata, and Trematospira multistriata**	20.0	338.6
	Devil's Backbone, Cumberland, Maryland.	Massive gray limestone, with bands of chert, becoming thin-bedded above, with partings of shale; characterized by **Spirifer macropleurus**	29.0	318.6
Coeymans Member. 8.6 feet.	Devil's Backbone, Cumberland, Maryland.	Massive, regularly bedded, blue-gray limestone. The upper bed of this unit forms the prominent ridge of the "Devil's Backbone," near Cumberland. Containing **Gypidula coeymanensis, Spirifer cyclopterus,** and stems of **Lepocrinites**	8.6	289.6
Keyser Member. 281 feet.	Keyser, West Virginia.	Thin- to medium-bedded gray limestone with fine brown lines, nearly unfossiliferous, **Leperditia altoides**	17.3	281.0
		Compact gray limestone, thin-bedded	3.4	263.7
		Gray crystalline limestone	0.8	260.3
		Heavy-bedded gray limestone with many transverse calcite seams **Spirifer vanuxemi prognosticus**	29.2	259.5
		Shaly limestone containing fossiliferous crystalline layers. Weathers more easily than adjoining units **Tentaculites gyracanthus, Schuchertella prolifica, Meristella praenuntia**	7.2	230.3
		Thin-bedded gray limestone **Tentaculites gyracanthus**	10.6	223.1
		Heavy-bedded, dark blue limestone, bottom foot argillaceous **Rensselaeria mutabilis**	25.7	212.5
		Massive bed of dark blue limestone spotted with crinoids and corals preserved in calcite	16.6	186.8
		Heavy-bedded, dark blue limestone, gray and crystalline toward the top	26.0	170.2
		Dark-blue limestone, heavy-bedded below, becoming thin-bedded toward top	9.0	144.2

			Feet.	Feet.
Keyser Member. (Concluded.) 281 feet.	Keyser, West Virginia.	A solid heavy bed of blue limestone **Gypidula coeymanensis var. prognostica (aa)**	2.0	135.2
		Heavy-bedded, dark blue limestone **Camarocrinus stellatus**	5.6	133.2
		Thin, irregularly bedded, dark blue limestone	6.0	127.6
		Thin, irregularly bedded, dark blue limestone	13.6	121.6
		Heavy-bedded, blue limestone. The cystid zone	18.0	108.0
		Heavy-bedded, dark blue limestone	24.0	90.0
		Heavy-bedded, dark blue limestone	27.0	66.0
		Very massive, hard, dark nodular limestone	20.3	39.0
		Dark, thin-bedded very nodular limestone	3.1	18.7
		Nodular limestone, with some chert	15.6	15.6

No attempt was made to secure a differentiated collection from all zones of the Helderberg in the two counties, but four small collections were made by the writer to determine contacts and doubtful stratigraphy and seven more ample collections across the face of the formation were later made by Scheffel and Price, all of which, as examined by Drs. Tilton and Prouty, will be found in Chapter XXI along with appropriate descriptions of localities.

The following is a summarized list of all fossils identified by Drs. Tilton and Prouty from the Helderberg Limestone in the two counties, there being included one collection from Hardy County and another from Allegany County, Maryland:

Fenestella cumberlandica Ulrich and Bassler
Cladopora (rectilineata ?) Simpson
Cladopora sp.
Rhynchospira globosa Hall
Rhynchospira cf. formosa Hall
Bryozoa (four undetermined forms)
Leperditia altoides Weller
Leperditia sp.
Loxonema fitchi Hall
Pleurotomaria labrosa Hall (?)
Bellerophon auriculatus Hall
Meristella arcuata Hall (?)
Meristella arcuata Hall
Meristella sp.
Crinoid stems
Strophonella punctulifera Conrad
Strophonella headleana Hall
Atrypa reticularis Linnaeus
Stropheodonta cf. coeymanensis Swartz
Stropheodonta beckii Hall
Stropheodonta cf. bipartita Hall
Stropheodonta cf. veristriata Conrad
Dalmanella cf. clarki Maynard
Dalmanella cf. perelegans Hall
Trematospira?
Rensselaeria subglobosa var. avus Schuchert
Rhipidomella sp.

Stromatopora constellata Hall
Spirifer cf. macropleura Conrad
Spirifer macropleura Conrad
Spirifer perlamellosus Hall
Spirifer cf. concinnus Hall
Spirifer vanuxemi Hall (May be in fragment of Bossardville)
Schuchertella woolworthana Hall
Schuchertella sp.
Leptaena rhomboidalis Wilckens
Streptelasma strictum Hall
Eatonia sp.
Zaphrentis sp.
Cf. Hindia spheroidalis Duncan
Favosites helderbergiae var. praecedens Schuchert
Camarotoechia sp.
Chonetes sp.
Aulipora sp.
Tentaculites cf. gyracanthus Eaton
Hindella congregata var.
Hormatoma sp.

SUBDIVISIONS, HELDERBERG LIMESTONE.

In Maryland four subdivisions of the Helderberg are recognized in the following descending order:

Becraft
New Scotland
Coeymans
Keyser.

Of these four the Becraft, New Scotland, and Coeymans are New York titles and a proper correlation with these three subdivisions from typical localities to the Potomac River is therefore indicated. The eastern affinities of the Keyser Member, which was named at Keyser, Mineral County, West Virginia, and which comprises more than half of the Maryland and West Virginia Helderberg, have not been entirely established. As previously stated Dr. Swartz indicates a belief that it is contemporaneous with the combined Manlius, Rondout and Deckers Ferry of New York and New Jersey, but at the same time makes important qualifications and gives much space to the divergent views of Ulrich and others. From his summary it would appear that much more detailed work might be required to definitely correlate the Keyser with the classic region so that it is now advisable to hold its time relationships open for further study.

In Mineral and Grant Counties the Becraft Member is entirely absent, being restricted to territory east of Cumberland, and the descending succession for the two counties therefore becomes as follows:

New Scotland Chert
Coeymans Limestone
Keyser Limestone.

Attention will now be paid to these members in their regular order.

New Scotland Chert.

The **New Scotland Chert,** coming at the top of the Helderberg in the two counties and just underlying the Shriver Chert of the Oriskany, is distinctive both by its lithology and fauna. It consists in general of flaggy layers of alternating limestone and grayish-white, very hard chert, being distinguished from the Shriver Chert by its color, compactness, stratification, and fossils, so that the two may be readily separated when their contact is exposed which, unfortunately, is seldom the case. In early New York literature the New Scotland was known as the **Delthyris Shaly Limestone** from the presence of **Spirifer perlamellosus** which was then considered as Delthyris by the New York Survey, but in later years it has been given a place name to conform to modern usage.

In Mineral and Grant Counties the New Scotland attains a greater thickness than in Maryland, being recorded as 66 feet in the Limestone Run Section near Keyser, 50 feet in the Maysville Section, Grant County and 130 feet in the Falls Section, Grant County. Along Knobly Mountain it is conspicuous in many of the high points, since it weathers very slowly, and it is a landmark in the top of Rock Hill about one mile south of Dawson where it forms the summit of a high cliff that overlooks the Potomac, the cherty portion of the ledge being about 100 feet thick, cavernous at the base and fossiliferous at the top. At the northern end of the main mass of Patterson Creek Mountain it covers most of the surface of what is known as Twin Mountain, the wavy structure at that locality making its outcrop much wider than is usually the case. At the southern end of Patterson Creek Mountain, also, its debris covers a large amount of ground, being conspicuous in the gap which South Branch makes through the mountain. In the Smokehole Settlement of Grant County it is much in evidence, many of the steep slopes being littered with its fragments and one of its outcrops being at the mouth of Peacock Cave.

Coeymans Limestone.

The **Coeymans Limestone,** coming next below the New Scotland Chert, is a thin member described by the Maryland Survey as being 8 to 13 feet in thickness, "Massive, blue, crystalline limestone, commonly crinoidal and containing a small amount of chert." The further statement is made that it contains local bands of thin sandstone which weather less

slowly than the calcareous portions, this effect being noticed at Dawson and elsewhere. Known originally as the **Pentamerus Limestone** and later as the **Lower Pentamerus Limestone**, its name was finally given geographic significance in New York where it has long been studied. **Gypidula coeymanensis** is listed as its guide fossil, but other species are also numerous.

In Mineral and Grant Counties the Coeymans is not conspicuous, although it has been recognized by the Maryland Survey at Keyser, as published in the Lower Devonian volume, page 167, being 14.3 feet thick and containing both chert and sandstone. In the Limestone Run Section of the writer, page 139, this member has evidently been included under the New Scotland Chert, as the combined Maryland measurement of the two is almost the same as the writer's New Scotland. At other points in the two counties no attempt was made to segregate this member from the New Scotland to which it has strong lithologic resemblance. The interpretation of the New Scotland and Coeymans by the Maryland Survey at the quarry of the Standard Lime and Stone Company just east of Keyser is of much interest and is herewith published from the Lower Devonian volume, page 167:

New Scotland Member.	Vertical Thickness. Feet.
Fissile drab shale	14.0
Gray limestone and interbedded white chert. The chert is in layers 6 to 9 inches thick and forms almost the entire unit. 4.6 feet to 3.6 feet above the base of the unit occurs **Spirifer macropleurus**, at 1.6 feet **Meristella arcuata**	21.5
Medium-bedded gray limestone with some chert layers. 4.5 feet above the base of the unit occur **Phacops logani, Dalmanella perelegans, Schuchertella woolworthana, Spirifer macropleurus**	5.1
Shale much weathered	0.2
Black speckled crinoidal limestone, rather coarse grained with one chert layer	1.1
Thickness of New Scotland Member	41.9
Coeymans Member.	
Thin-bedded gray crinoidal limestone, with one chert band. At middle of unit occurs **Strophonella leavenworthana**	2.5
Shaly limestone, with chert layer	1.0
Shale weathered to clay	0.5

	Vertical Thickness. Feet.
Massive gray crinoidal bed with one 6-inch bed of chert	3.5
Massive gray crystalline limestone. Between 2 and 2.7 feet above base of unit are a number of bands of sand which weather out as brown ridges. At base of unit occur Atrypa reticularis, Cypidula coeymanensis (a), Schuchertella woolworthana, Stropheodonta sp., Lioclema subramosum	6.8
Thickness of Coeymans Member	14.3

Keyser Limestone.

The **Keyser Limestone,** being the basal member of the Helderberg as now recognized in the Potomac region, and comprising more than half of its mass, has been named by Swartz and others from the quarry of the Standard Lime and Stone Company, just east of the mouth of Limestone Run and about one-half mile east of Keyser, Mineral County, and is therefore typical of the territory of this Report. It is described (Lower Devonian volume, page 85) as "Limestone, massive and very nodular in its lower part, more shaly and thin-bedded above. Contains numerous reefs of corals and stromatoporoids. Thickness 270-290 feet. Zone of **Spirifer modestus,**" Under the subject of "Correlation" (Lower Devonian Volume, pages 98-99) it is further described and divided into faunal zones and subzones by Dr. Swartz as follows:

Keyser Member.

"Two rather well-defined lithological units may be recognized in the Keyser member. The lower of these is a nodular limestone varying from 100 to 130 feet in thickness, while the upper division is rarely nodular and contains many shaly beds. This member may also be divided into two faunal zones, although the limits of the lithological divisions do not coincide precisely with those of the faunal zones.

"The lower faunal zone is here termed the **Chonetes jerseyensis zone.** It is about 110 feet thick and is characterized by the presence of **Chonetes jerseyensis** and associated species. The upper zone is termed the **Favosites helderbergiae** var. **praecedens zone** from the abundance of that coral in it. The fossils found in the latter zone differ to a large extent from those of the **Chonetes jerseyensis zone.**

"A conspicuous feature of the Keyser member is the existence in it of at least five thick reefs of corals and stromatoporoids. It was long supposed that but two such reefs were recognizable in Maryland, both of which are exposed at the Devil's Backbone. Further study, however, has shown the presence of similar reefs at other horizons. These reefs are of wide extent. They are usually very resistant to weathering and stand out as massive ledges on the hillsides, the

weathered stromatoporoids presenting a singular curly and knotted appearance.

"Both the **Chonetes jerseyensis** and **Favosites helderbergiae var. praecedens zones** may be further divided into a number of subzones, each of which is characterized by some diagnostic feature as shown in the following table:

Keyser Member	Favosites helderbergiae var. praecedens zone.	Leperditia subzone. Corriganville Upper Stromatopora reef. Tentaculties gyracanthus subzone. Corriganville Lower Stromatopora reef. Rensselaeria mutabilis subzone. Keyser coral reef.
	Chonetes jerseyensis zone.	Bryozoan subzone. Gypidula coeymanensis var. prognostica subzone. Spirifer modestus-cystid subzone. Rawlings Stromatopora reef. Cladopora rectilineata subzone. Rhynchospira subzone Warrior Mountain coral reef."

The detailed measurement and intensive study made by Dr. Swartz and associates at the western quarry of the Standard Lime and Stone Company on the south side of the Potomac about one-half mile east of Keyser and published on pages 134-136 of the Lower Devonian volume in descending order is quite complete, both in regard to lithologic appearance and faunal content, and is herewith republished. It is stated in explanation that numbers following fossil names indicate the altitude in feet at which they occur above the base of the formation:

Keyser Member.	Vertical Thickness. Feet.	Total Vertical Thickness. Feet.
Thin- to medium-bedded gray limestone, nearly unfossiliferous throughout, with fine brown lines. **Leperditia altoides** 27.7 (277. ?)	17.3	281.0
Compact gray limestone, thin-bedded. At top of unit occur **Leperditia altoides** (a), **Meristella praenuntia, Nucleospira** sp.,		

	Vertical Thickness. Feet.	Total Vertical Thickness. Feet.
Uncinulus sp. At base occurs **Lioclema subramosum**	3.4	263.7
Gray crystalline limestone	0.8	260.3
Heavy- bedded gray limestone with many transverse calcite seams. **Meristella praenuntia** var. small, **Spirifer vanuxemi** var. **prognosticus, Lioclema subramosum** 256.7, **Schuchertella prolifica** 234.5	29.2	259.5
Shaly limestone containing fossiliferous crystalline layers. Weathers more easily than the adjoining units. **Schuchertella prolifica** and **Tentaculites gyracanthus** occur in abundance at 223.1, 223.5, 225.1, 226.1, **Meristella praenuntia,** abundant 223, 225.1, **Uncinulus keyserensis** 223.1, 225.1, **Uncinulus nucleolatus ?** 225.1, **Lioclema subramosum** 223.5, 225.1	7.2	230.3
Thin-bedded gray limestone **Tentaculites gyracanthus** in abundance 213.5, 216.7, 217, 218.1, 219.5, **Uncinulus keyserensis** 213.5, 214 (a), 216.7, 217, 217.8, 218.1, **Meristella praenuntia** 212.7, 214 (a), 214.7 (a), 216.7 (a), 217, **Schuchertella prolifica** 213.5, 217	10.6	223.1
Heavy-bedded, dark blue limestone, bottom foot argillaceous. **Uncinulus keyserensis** occurs throughout, more abundantly, however, at 189.8, 195.2. **Meristella praenuntia** throughout the unit; **Uncinulus nucleolatus** 211.2; **Rensselaeria mutabilis** 195.2; **Bryozoa** 193.6	25.7	212.5
Massive bed of dark blue limestone spotted with crinoids and corals preserved in calcite. **Favosites helderbergiae** var. **praecedens** (a), **Cyathophyllum marylandicum** (a), **Tentaculites gyracanthus, Beachia proavita, Meristella praenuntia, Uncinulus keyserensis** 186.4, **Uncinulus nucleolatus** 171.2, 182.2, 184.2; **Meristella praenuntia** 182.2	16.6	186.8
Heavy-bedded, dark blue limestone, gray and crystalline toward the top. Crinoid fragments, **Merista typa** and **Uncinulus keyserensis** 169.2	26.0	170.2
Dark blue limestone heavy-bedded below, becoming thin-bedded toward top **Atrypa reticularis, Chonetes jerseyensis, Rhynchospira formosa** 140	9.0	144.2
A solid heavy bed of blue limestone. **Gypidula coeymanensis** var. **prognostica** throughout	2.0	135.2
Heavy-bedded, dark blue limestone containing **Camarocrinus stellatus** (a), **Tentaculites**		

Photo by E. E. HARRIS.

PLATE XIX.—Faulted strata on south side of South Branch of Potomac River where this stream cuts through Patterson Creek Mountain east of Petersburg. Upper cliff is Oriskany Sandstone. Lower cliff is Helderberg Limestone. See Figure 6.

	Vertical Thickness. Feet.	Total Vertical Thickness. Feet.
gyracanthus, Trimerocystis peculiaris, and Calymene camerata	5.6	133.2
Thin, irregularly bedded, dark blue limestone. At the top of this unit occurs Spirifer modestus	6.0	127.6
Thin, irregularly bedded, dark blue limestone. Seven feet below top of this unit were found Stenochisma formosa ?, Schuchertella deckerensis, Uncinulus convexorus, Platyostoma sp.	13.6	121.6
Heavy-bedded blue limestone. Atrypa reticularis, Schuchertella deckerensis, crinoids. Between 100 to 133 feet vertically a profusion of cystids is found including Sphaerocystitis multifasciatus (aa), S. globularis (a), Pseudocrinites gordoni (a), Jaekelocystis hartleyi (a), Pseudocrintes stellatus, P. clarki, P. perdewi, Jaekelocystis papillatus, J. avellana, Lepocrintes manlius, Tetracystis chrysalis. At bottom occur Atrypa reticularis, Schuchertella deckerensis, Uncinulus convexorus, Platyostoma sp.	18.0	108.0
Heavy-bedded dark blue limestone, Camarotoechia sp., Spirifer sp., Atrypa recticularis (a), Tentaculites gyracanthus, Fenestella cumberlandica 80, Lioclema subramosum, Batostomella interporosa, Fistuliporella cumulata, Atrypa reticularis, Rhynchospira formosa, Schuchertella sp. 73.8, Uncinulus sp. 73, Camarotoechia litchfieldensis 66	24.0	90.0
Heavy-bedded, dark blue limestone. Very nodular toward bottom, Camarotoechia litchfieldensis, Uncinulus convexorus, Whitfieldella minuta 65, Atrypa reticularis, Camarotoechia concinna, Murchisonia ? sp., Stenochisma formosa ? 58.4, Atrypa reticularis, Chonetes jerseyensis, Rhipidomella sp., Rhynchospira formosa, Spirifer eriensis 58, Camarotoechia litchfieldensis 50 and 47, Cyphotrypa corrugata, Camarotoechia litchfieldensis, Chonetes jerseyensis, Rhynchospira formosa; Schuchertella sp., Uncinulus convexorus 39	27.0	66.0
Very massive, hard, dark, nodular limestone. The top of this unit forms the second large bedding-plane above the base of the Keyser. Atrypa reticularis, Chonetes jerseyensis, Stenochisma formosa, Spirifer octocostatus, Stropheodonta bipar-		

	Vertical Thickness. Feet.	Total Vertical Thickness. Feet.
tita, crinoid rings. **Camarotoechia litchfieldensis, Whitfieldella minuta** 23	20.3	39.0
Black, thin-bedded, very nodular limestone. **Camarotoechia litchfieldensis** 18	3.1	18.7
Nodular limestone with some chert. **Stropheodonta bipartita, Whitfieldella minuta**, ostracods 9.4. **Stropheodonta bipartita**, ostracods 1	15.6	15.6
Thickness of Keyser member	281.0	

Tonoloway Formation.

Fissile calcerous shales	8.0	
Concealed.		

"The following species have been identified from the Keyser Member at this locality, but their exact stratigraphic position is not known:

Hindia sphaeroidalis, Tentaculite zone.
Zaphrentis keyserensis.
Cladopora rectilineata.
Aulopora schucherti.
Ceratopora marylandica, Tentaculite zone.
Ceramopora micropora.
Atrypa biconvexa.
Dalmanella concinna.
Nucleospira swartzi, Lower beds.
Camarotoechia lamellata, Lower beds.
Rhynchospira globosa, Lower beds.
Rhipidomella emarginata, Lower beds.
Schuchertella marylandica, Lower beds.
Spirifer modestus var. plicatus.
Whitfieldella nucleolata."

The above quotations leave little to be said in further description of the Keyser Limestone at its type locality, except to state that it occupies only a portion of the western of the twin quarries at the point named, the eastern end of this quarry and all of the more eastern quarry being in the Silurian.

In the remainder of Mineral County and also in Grant, the Keyser Limestone is a generally massive, pure, calcareous bed, its thickness apparently varying from 275 to about 475 feet, and its outcrop as a portion of the Helderberg having already been described. It has been quarried and burned for agricultural lime at various points and has also been used for road material, to both of which purposes it is admirably adapted.

ECONOMIC ASPECTS, HELDERBERG LIMESTONE.

The New Scotland and Coeymans members of the Helderberg are generally too siliceous to be quarried and used when pure limestone is desired. The New Scotland has a peculiar economic interest, however, because of the discovery in recent years that fruit trees of almost every description flourish on its outcrop, even in localities where there is seemingly scarcely enough soil for tree growth. On Knobly Mountain, the northern end of New Creek Mountain, Twin Mountain, and portions of Patterson Creek Mountain, and in other ridges where it is found, the combined outcrops of the Shriver and New Scotland Cherts and possibly the Coeymans Limestone as well have been cleared off for horticulture and afford a rich yield when early frosts do not kill the fruit. A sample (No. 541R) of the New Scotland ledge was collected from the land of the Keyser Orchard Company on the extreme summit of Rock Hill, Mineral County, 0.8 mile southward from Dawson, and another (No. 544R) was secured from surface debris of New Scotland type on the lands of the Chert Mountain Orchards at the Elliber Spring, Mineral County, 1½ miles northeast of Twin Mountain village. The composition of these two samples is as follows, according to Kaplan:

	Keyser Orchard. Co. (541R). Per cent.	Chert Mountain Orchards. (544R). Per cent.
Silica (SiO_2)	64.10	90.92
Ferric Iron (Fe_2O_3)	2.50	6.50
Alumina (Al_2O_3)	1.64	1.88
Lime (CaO)	.....	0.50
Calcium Carbonate ($CaCO_3$)	28.98	.....
Magnesia (MgO)	.....	0.15
Magnesium Carbonate ($MgCO_3$)	1.07	.....
Potassium (K_2O)	0.36	.....
Sodium (Na_2O)	0.62	.....
Phosphoric Acid (P_2O_5)	0.18	0.14
Loss on Ignition	0.15	0.18
Totals	99.60	100.27

The analyses reveal a greatly differing quantity of silica and calcareous matter (lime or calcium carbonate) as might be expected from a bed containing both limestone and sandy chert and it is not to be assumed that the chemical quality of the chert is any proper index of the value of the land on which it is found. It is rather to be believed that the scanty soil finding lodgment in the crevices and doubtless possessing

ingredients that have now almost entirely weathered out of the original rock is accountable for the growth of trees and production of fruit.

The Keyser Limestone is comparatively pure, being usually fit for agricultural lime, although its silica content is sometimes too high. It has been used extensively for road material for which it is well adapted and affords an inexhaustible amount widely scattered through the two counties. It also weathers into good agricultural soil and under favorable conditions beds of marl are derived from it. A description of both limestone quarries and exposures, together with chemical analyses and a further discussion of the Helderberg as compared to other limestones, and also an account of the marly beds will be found in Chapter XVIII under the general subject of "Limestone."

CHAPTER XIV.

STRATIGRAPHY---SILURIAN ROCKS.

INTRODUCTION.

As indicated in the General Columnar Section, pages 85-87, the Silurian Rocks of Minaral and Grant Counties have been classified as follows, in descending order, certain titles being added in parentheses to indicate supposed contemporaneous nomenclature that for various reasons does not seem entitled to first place:

Salina Formation.	Thickness. Feet.	Total. Feet
Bossardville Limestone (Tentaculite, Manlius, Tonoloway; probably includes Decker Ferry near top)	200 to 400	400
Rondout Waterlime (portion of Onondaga Salt Group of New York; Poxono Island Shales and Limestone of Pennsylvania; also upper portion of Wills Creek Shale of Pawpaw-Hancock Folio)	200 to 400	800
Bloomsburg Red Shale (portion of Onondaga Salt Group of New York; lower portion of Wills Creek Shale of Pawpaw-Hancock Folio)	50 to 100	900
Niagara Limestone (McKenzie of Pawpaw-Hancock Folio)	150 to 400	1300
Clinton Series (Rockwood and Cacapon of United States Geological Survey Folios)	300 to 600	1900
White Medina Sandstone (Tuscarora or Clinch of United States Geological Survey Folios)	200 to 300	2200
Red Medina Series (Juniata of United States Geological Survey and other Reports)	700 to 1100	3300
Gray Medina Sandstone (Oswego, Oneida?, Shawangunk?)	250 to 300	3600

It is evident from the above summary that these rocks vary in thickness from a minimum of 2050 feet to a possible maximum of 3600 feet. It has not been possible to measure the entire succession in detail at any particular locality but there are good exposures of all the individual groups, the range of thicknesses found being indicated in the first column.

It is not believed that either the maximum or minimum total thickness of the entire Silurian would be found at any point if a complete measurement were possible but that an intermediate figure of 2500 or 3000 feet would be obtained. In Maryland Prosser[1] states in a paper that the Silurian is from 2200 to 2400 feet, and in Pennsylvania Lesley[2] gives a section that he regards as typical of that State, measured at Logan Gap, Mifflin County, in which a thickness of 5,384 feet is recorded. This section is of much interest in connection with the study of Silurian beds in West Virginia and is here reproduced in descending order as follows:

Logan Gap Section, Mifflin County, Pennsylvania.

			Feet.
j.	Salina gray shale		164
k.	Salina variegated shale	348′	
l.	Logan limestone	3½	423
m.	Logan shale	72	
n.	Salina upper red shale		432
o.	Salina upper lime shale		326
p.	Salina lower red shale		272
q.	Clinton lower (upper?) shale		251
r.	Clinton upper olive shale		
s.	Ore sandstone and ore beds		38
t.	Clinton middle olive shale		178
u.	Iron sandstone		7
v.	Clinton lower olive shale		571
w.	Medina white sandstone		820
x.	Medina red sandstone and shale		1280
y.	Oneida red conglomerate		309
z.	Oneida gray sandstone		313
			5384

a.a. Hudson River slates.

It is evident from the above that a southwestward thinning in the Salina beds has occurred, the total of these in Pennsylvania being 1617 feet while in Mineral and Grant Counties they have a range of 450 to 900 feet and are principally composed of limestone instead of shale, but in Pennsylvania the Bossardville Limestone is not always included in the Salina and would increase still further the thickness of the formation. The Niagara is not recorded as such in the Logan Gap Section but it may be represented in Member Q, there being a total recorded Clinton of 1045 feet as compared with 300 to 600 feet in Mineral and Grant. In the

[1] C. S. Prosser, Jour. Geol., Vol. 9, p. 410; 1901.

[2] J. P. Lesley, Summary Report, Geological Survey of Pennsylvania, Vol. 2, p. 787; 1892.

latter counties the fossil ore bed comes at the top of the formation, just beneath the Niagara Limestone, and also the Iron Sandstone rests almost directly on the White Medina, so it is evident that the middle part of the Clinton is still present and its top and bottom have mostly vanished. The White Medina at Logan Gap measures 820 feet but in Mineral and Grant is reduced to 300 feet or less; and there is also a loss in the Red Medina (X and Y) from 1589 feet to 1100 feet.

The Silurian Rocks of the three eastern counties of West Virginia have been described by Grimsley[3], a thickness of 1920 feet being indicated, or considerably less than the figures for Mineral and Grant Counties or for Maryland as given by Prosser.

A comparison with the Silurian of New York State as now classified by Clarke and Schuchert[4] is afforded in the following column, the order of which has been reversed to descending succession in harmony with the West Virginia Reports, but no statement of thicknesses is made:

Period or Group.	Age or Stage.
Cayugan (Neontaric)	Manlius Limestone Rondout Waterlime Salina Beds
Niagaran (Mesontaric)	Guelph Dolomite Lockport Limestone Rochester Shale Clinton Beds
Oswegan (Paleontaric)	Medina Sandstone Oneida Conglomerate Shawangunk Grit

In the above column the Salina Beds are evidently much the same as the **Onondaga Salt Group** under which these very interesting deposits were previously described by James Hall and others, the name "Onondaga" having been later transferred, for reasons that are not clear, to a formation lying above the Oriskany of the Devonian. The precise relationships of the four stages listed under the Niagaran Period or Group, as compared to the column adopted in the beginning of this Chapter, are not immediately apparent but they evidently correspond in the main with the Niagara and Clinton, as they occupy the same interval. In the Oswegan Group

[3] G. P. Grimsley, Jefferson, Berkeley, and Morgan Report, West Virginia Geological Survey, pp. 240-253; 1916.

[4] J. M. Clarke and Charles Schuchert, Science, New Series, Vol. 10, p. 876; 1899.

the Medina Sandstone is plainly the same as the White Medina of both Pennsylvania and West Virginia and the Oneida Conglomerate clearly correlates in part with Member Y of the Logan Gap Section, but the horizon of the Shawangunk in States west of New York is somewhat uncertain. In New York it is evidently considered a substage of the Oneida Conglomerate, but in Ulster County its position is noted by Darton[5] as being just above the Hudson River Formation and above it there occur red shales and sandstones followed by a very thin quartz conglomerate. If this thin conglomerate should represent an attenuated phase of the White Medina it might be possible that the Shawangunk is the same as Member Z of the Pennsylvania section which correlates with the Gray Medina of this Report. Dr. I. C. White[6] states that the Oneida Sandstone (the same as Member Z of Lesley's section) is conglomeratic along the New York and New Jersey borders and in fact terms it as the "Oneida Conglomerate" in his report on Pike and Monroe Counties above cited. Difficulties in the way of accepting such a view are the well-known fact that quartz conglomerates above the Shawangunk at its type locality are generally insignificant, making it appear that the Shawangunk mikht be the same as the White Medina, and the further fact that in the revised New York section of Clarke and Schuchert the Richmond Beds of Ohio and Indiana follow just below the Shawangunk. It is stated by Bassler[7] that the Richmond Beds correlate with the Juniata (Red Medina of this Report), the latter being merely a continental expression of the fossiliferous Richmond. Such an interpretation of the Red Medina would put the Shawangunk above the Red Medina instead of below it. The writer is much inclined to doubt the propriety of correlating the fossiliferous Richmond Beds with any portion of the Medina, which with a few exceptional localities is distinctly littoral or continental in its affinities, and believes that the Richmond Beds belong in the Ordovician, as placed by Clarke and Schuchert, and that they therefore become a constituent part of the Martinsburg or Hudson River epoch in which marine

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[5] N. H. Darton, 47th Report, New York State Museum, p. 491; 1894.

[6] Report G6, Second Geological Survey of Pennsylvania, pp. 150-151; 1882.

[7] R. S. Bassler, Cambrian and Ordovician Volume, Maryland Geological Survey, pp. 161 and 171; 1919.

conditions were generally prevalent until they suddenly ended with the beginning of Medina time. If that be true there is no serious obstacle against correlating the Shawangunk of New York State with the Gray Medina of West Virginia, the relationship to the Hudson River or Martinsburg being essentially the same in both States.

The above comment on the Medina stages reveals in part the attitude that is herein taken toward the Silurian-Ordovician contact. In many publications, including folios of the United States Geological Survey, this boundary is taken at the base of the White Medina (Tuscarora) Quartzite, the Red Medina (Juniata) being placed in the Ordovician, and necessarily also the Gray Medina (Oneida) when present. In the Cambrian and Ordovician volume of Maryland, Bassler has placed the Juniata in the Ordovician, stating at the same time (page 172) that this is done in order to harmonize with the (then unpublished) volume on the Silurian of that State where the Tuscarora has been taken as the basal Silurian, but stating further that in previous publications he has always considered the Richmond (which he correlates with the Juniata) as Silurian and that his views have not changed. As indicated above, the top of the Martinsburg or Hudson River Shale marks the end of a long, undisturbed epoch of marine deposition and the base of the Gray Medina marks the beginning of another epoch, not so long in time but perhaps of equal importance considering the diastrophic action involved, in which littoral or continental conditions prevailed. The unconformity that occurred between these two epochs, therefore, must have been greater than that which took place at the end of the Red Medina (Juniata) making it seem more logical to draw this line at the base of the Gray Medina. An interesting discovery bearing on this mooted question was recently made by Dr. Prouty and the writer along the Virginia-West Virginia border at the summit of East River Mountain south of Bluefield, West Virginia, where the presence of **Arthrophycus**, species not identified by Dr. Prouty but probably **harlani,** was noted in both the White and Red Medina formations, indicating that an extensive hiatus between the two could hardly have occurred.

The upper limit of the Silurian has always been the subject of much debate. In the early study of the Devonian and Silurian in North America, the top of the Silurian was first placed as high as the base of the Catskill Series but this hasty view was soon abandoned, the studies of de Verneuil, published in 1847, having demonstrated that it was not above the base of the New York Oriskany. For many years this

junction of sandstone with calcareous sediments was generally accepted but in 1899 Clarke and Schuchert proved that few of the characteristic Silurian trilobites, brachiopods, and crinoids passed from the lower calcareous beds up into the Helderberg Limestone, and further that a much greater proportion of Helderberg fauna could be found in the Oriskany. Such being the case it was concluded that this paleontologic unconformity coming in the midst of extensive limestone deposits was the governing factor and with this view most authors in recent years have agreed.

The delimitation of this contact in the typical beds of New York State, however, has by no means settled the problem on the Potomac River. From New York State westward to Cumberland and Keyser where the limestones of the Silurian and Devonian pass under drainage and so remain across the Appalachian Geosyncline, there is a progressive thickening of these calcareous sediments between the base of the Oriskany Sandstone and the top of the Clinton Series. In Ulster County, New York, Darton[8] gives this interval as varying from 185 to 403 feet. In northeastern Pennsylvania along the New York and New Jersey line, Dr. White[9] shows a total of 435 to 566 feet. In Maryland the Silurian column for the whole State is not yet available* but the beds have been studied by Stose and Swartz in the Pawpaw-Hancock area,[10] their total varying from 1285 to 1525 feet; and by Grimsley[11] in the three eastern counties of West Virginia in territory that is in part the same as the Pawpaw-Hancock area, his figure being 1270 feet; and in Allegany County, Maryland, by Prosser[12] and O'Harra,[13] whose totals vary from 1700 to 1900 feet. In the area now under study the totals show a range of 900 to 1900 feet but it is probable that

[8] N. H. Darton, 47th Report, New York State Museum, p. 491; 1894.

[9] I. C. White, Report G6, Second Geological Survey of Pennsylvania, pp. 128-129; 1882.

* This volume has later come off the press, the total for these calcareous beds being 1580 to 1690 feet.

[10] G. W. Stose and C. K. Swartz, Pawpaw-Hancock Folio, No. 179, United States Geological Survey; 1912.

[11] G. P. Grimsley, Jefferson-Berkeley-Morgan Report, West Virginia Geological Survey, p. 114; 1916.

[12] C. S. Prosser, Journal of Geology, Volume 9, pp. 413-416; 1909.

[13] C. C. O'Harra, Geology of Allegany County, pp. 91-98, Maryland Geological Survey; 1900.

1700 feet would be about the proper figure if a consecutive measurement of these beds were possible. It is thus seen that this assemblage of calcareous rocks is more than four times as thick along the Potomac River as in Ulster County, New York, and increases have occurred in nearly every formation.

Attempts to follow the typical New York Siluro-Devonian limestones westward to this region of greater thickness have not been entirely harmonious. In the Maryland volume on Lower Devonian (page 113), Dr. Swartz concludes that the Helderberg includes not only the Becraft, New Scotland, and Coeymans of New York, but also the Manlius, Rondout, and Decker Ferry as well, basing his belief on the presence of some typical marine forms of the latter three formations in the Keyser Member of the Helderberg, but most other authors keep all the latter three formations in the Silurian and some even go so far as to put the Decker Ferry in the Niagaran Group.

In reviewing this problem in such particulars as it pertains to the correlation of these beds in Mineral and Grant Counties, it will perhaps suffice to start at Rondout, New York, where the typical waterlime beds have been studied by Darton,[14] as published in the "Geology of Ulster County." Here the following succession in descending order is noted (page 491) between the Oriskany and Clinton:

Name.	Age.	Character.	Thickness.
Upper Shaly Limestone	Helderberg	Impure limestone	30-125
Becraft Limestone		Limestone	20- 30
Lower Shaly Limestone		Impure limestone	60
Pentamerus Limestone		Dark massive limestones	30- 60
Tentaculite Limestone		Thin-bedded limestones	20-40
Cement Series	Salina	Cement and waterlime	20- 50
Niagara Limestone	Niagara	Coralline limestone	0- 8

All of the above beds were classified as Silurian according to the older usage under which the Helderberg was made to include all the beds above the Salina, but as previously stated the Helderberg has now been shown to be Devonian and its lower limit in New York State has now been placed at the base of the Coeymans Limestone which correlates with the Pentamerus; and the Tentaculite Limestone, which corresponds to the Manlius of present New York literature,

[14] N. H. Darton, New York State Museum, 47th Report, pp. 485-566; 1894.

has been put under the Silurian by Clarke and Schuchert. Describing the Tentaculite and Cement beds in more detail, Darton says the following (pages 499-501):

"Tentaculite limestone.—This is in greater part a thin-bedded, dark-blue limestone constituting the basal members of the Helderberg limestones. The beds are for the most part from two to three inches thick and they separate along smooth bedding-planes. The formation has a thickness of from twenty to forty feet, its greatest development being in the vicinity of Rosendale and Rondout. There is included at or near its base, notably in the quarries near Rondout, a dark-gray, impure limestone containing many corals and representing the Stromatopora horizon. The Tentaculite beds appear to be continuous throughout, but they are usually hidden by the talus from the Pentamerus cliffs above, and outcrops are rare. They are well exposed in the cement quarries at Rosendale, Whiteport, East Kingston, and Rondout, and also near West Camp.

"The Salina waterlime beds. These members are a southeastern extension of the Salina formation of central New York, and the cement beds which they here carry are the most important mineral resource of Ulster County. The usual characters of the formation are thin-bedded water limestones and the cement is of local occurrence. It is a blue-black, very fine-grained, massively bedded deposit, consisting of calcareous, magnesian, and argillaceous materials in somewhat variable proportions. The beds are extensively developed in the Rondout and Rosendale regions. They come in gradually and are attended by a thickening of the formation from its usual average of twenty to thirty feet to forty or fifty feet. At Rondout the principal cement bed has a thickness averaging about twenty feet. It lies directly on the coralline (Niagara) limestone and is overlaid by alternating successions of waterlime and thin impure cement beds. The cement horizon is not exposed far north of East Kingston, but how far it extends to the northward is not known. It is seen to thicken southward and it attains its maximum thickness in the vicinity of Rondout, thinning out again and giving place to waterlime beds south of Wilbur. It is seen to have come in again in the Whiteport anticlinal, which brings up a great development of cement beds along its principal axis from Whiteport to Rosendale. Some features of the beds in this region are shown in the plates. They also come out along the eastern limb of the synclinal eastward. To the south of Rosendale, the cement beds continue up the Coxingkill Valley and around the point of the anticlinal by High Falls on the Rondout creek. Above this place it can be traced but a short distance owing to its deep erosion and heavy drift cover in the Rondout Creek valley, but its reappearance near Port Jackson indicates that it probably continues for a considerable distance.

"In the Whiteport-Rosendale region there are two beds of cement, the lower averaging twenty-one feet in thickness, and the other averaging twelve feet in thickness with an intervening member of ten to fifteen feet of waterlime beds, but these amounts vary considerably. At High Falls the upper bed is fifteen feet thick, the lower bed five feet thick with three feet of intervening waterlime beds. The High Falls are over the thicker bed as is shown in the plates."

Speaking of the rocks overlying the cement beds in another locality, he says the following (pages 516-517):

"Overlying the upper cement bed there are several thin beds of impure limestones containing **Leperditia alta**, and, at their surface, prismatic mud-cracks, as noted by Lindsley. The Tentaculite limestones have a thickness of about twenty-five feet, of which the upper six feet are classed as the ribbon limestone by Lindsley and contain **Stromatopora**. The Pentamerus limestone constitutes the crest of the ridge, and outcrops in cliffs of light-gray color. It presents its usual character of a lead-gray massive limestone, and carries a considerable amount of chert in courses and disseminated lenses. It contains **Pentamerus galeatus** and crinoidal fragments. Its thickness was not determined, but it is fully thirty feet as stated by Davis. The lower shaly limestone extends along the center of the ridge with a thickness of about sixty feet, and the Becraft limestone lies high up on the western slope. Both dip steeply to the west. There are lime quarries in the Becraft beds which expose a thickness of about thirty-five feet of the usual heavily bedded, light-colored, highly fossiliferous limestone, containing abundant calcite replacements of crinoid cups. One of these quarries, lying north of the road from Kingston to Kingston Point, is shown in plate 5. The upper Shaly limestones extend down the western slope of the ridge. The full thickness of the formation is well exposed near the end of the northern loop of the railroad, where the ridge widens somewhat, and here also there are excellent outcrops of Oriskany beds, which are more widely eroded southward. The upper Shaly beds have a thickness of about 125 feet. They are similar to the lower Shaly beds, and consist of brownish-gray impure limestones traversed by slaty cleavage. They are, as usual, sparingly fossiliferous, containing **Leptaena rhomboidalis, Stropheodonta radiata, Spirifer macropleura, Spirifer periamellosus, Orthis oblata,** and others."

It will be noted in the above quotation that **Leperditia alta** is found in the Tentaculite or Manlius Limestone. This fossil has never been found in beds lying within the present limits of the New York Helderberg but it is found in the Tonoloway (Bossardville) of the Potomac region.[15] In Maryland a close relative, **Leperditia altoides** has been found in the Helderberg, the statement being made that it is a late form of **L. alta** (Lower Devonian of Maryland, page 102). It will also be noted that the peculiar banding which has often caused the Tentaculite or Manlius Limestone to be called the "Ribbon Limestone" is mentioned in Darton's description.

Passing now to the northwestern corner of New York a very complete section is afforded by a detailed record of a shaft dug for salt near Livonia, Livingston County, the characteristics of all beds from 380 feet to the bottom at 1432 feet having been observed by D. D. Luther, as published, together with comment by Dr. J. M. Clarke, in the 47th Report of the New York Museum, pages 219-372, inclusive. Omitting all details above the Helderberg Limestone and

[15] See quotation from Ulrich in Pawpaw-Hancock Folio, No. 179.

abridging somewhat the petrographic descriptions, this record is as follows:

Livonia Shaft Record.

Near Livonia, Livington County, New York.

	Thickness. Feet.	Total. Feet.
Unrecorded (Portage, Genesee, and Hamilton)	380	380
Hamilton Shale, details omitted	417	797
Marcellus Shale, details omitted	69	866
Corniferous Limestone, details omitted	132½	998½
Onondaga Limestone, details omitted	2½	1001
Oriskany Sandstone, details omitted	5	1006
Lower Helderberg Limestone (112′)		
Hydraulic limestone, dark to light chocolate. No fossils	4	1010
Hydraulic limestone, light colored. Fossils of a few species common. Spirifer vanuxemi very abundant through the rock and in thin layers. Strophеodonta varistriata, Leperditia alta and Liopteria rugosa also occur	14	1024
Sandstone, light gray	6	1030
Limestone, dark brown to yellowish-gray. A few species of Favosites at 1045′. No other fossils	39	1069
Limestone, hard, bluish-gray, shaly. No fossils	9	1078
Shale or marlite, hard, nodular, with gypsum	9	1087
Limestone, fine, brownish-gray, laminated, with gypsum	6	1093
Magnesian Limestone, with gypsum in crystals and nodules, but not very abundant. Leperditia alta occurs in a few thin layers between 1105′ and 1110′	25	1118
Salina Beds (314′)		
Shale, marlite, gypsum, and limestone often tinged with red. No fossils	230	1348
Salt, marlite, gypsum, limestone, etc., to bottom of shaft. No fossils	84	1432

It will be noted in the above record that Mr. Luther makes the (Lower) Helderberg include all the beds from the Oriskany Sandstone down to the beginning of the Salina as therein classified, but it is apparent that the Magnesian Limestone as well as some of the beds above it belong to the Manlius or Tentaculite, or possibly Rondout, since characteristic Helderberg fossils are almost entirely lacking, as the following comment by Dr. J. M. Clarke (page 348) will show:

"Following the sequence in its natural order from beneath upward, the first fossil encountered in the great thickness of hydraulic

limestone overlying the salt, is a large-sized **Leperditia** like **L. alta** and **L. Jonesi** in size and form and also resembling the species occurring in the Coralline liestone at Schoharie which was originally identified as **L. alta.** It would perhaps be difficult to say whether this is actually the characteristic species of the Tentaculite limestone (**L. alta**) appearing so early, or, if this is the case, whether the same species has not maintained an unmodified existence from the late faunas of the Niagara period. Our specimens being in the form of casts do not permit the determination of so nice a point. The favosite occurring at 1045′ also determines nothing, but from above this point where the lithological character of the rock changes noticeably, to 1010′, we have a well-developed limestone fauna.

"It is a noteworthy fact and one that has been frequently adverted to, that the Lower Helderberg series of strata loses its differentiation westward in New York beyond the region of its typical exposure; and the faunas of these separate divisions also lose their individuality. With the thinning of the formation to the west the faunas become commingled, more and more sparse, with a notable prevalence of that of the Tentaculite limestone, the basal member of the series, until finally, as shown in the Livonia section, the entire group is represented by a thickness of about thirty-five feet containing a fauna wholly composed of Tentaculite limestone species.

"The nearest point to the eastward of the Livonia meridian where a good exposure of the Lower Helderberg rocks has been carefully studied is near Union Springs in Cayuga county, at which place Prof. Williams has shown the presence of a considerable element from the upper faunas of the Lower Helderberg group, represented by such species as **Orthostrophia strophomenoides, Nucleospira ventricosa,** etc."

It is evident that Dr. Clarke considers the Tentaculite Limestone as extending up to 1010 feet and therefore including all the **Leperditia alta** fossils. The Rondout Limestone, if it exists at the Livonia Shaft, is not differentiated but it may be included in the Magnesian Limestone or in some of the beds classified as Salina.

Turning now to Pike and Monroe Counties in northeastern Pennsylvania along the New York and New Jersey border where the Bossardville Limestone was first described by Dr. I. C. White,[16] we find the following sections showing the interval between the Oriskany and Clinton:

Nearpass's Quarry Section.

	Feet.
1. **Oriskany,** cherty, limy, fossiliferous shales	50
Lower Helderberg.	
2. Shaly, calcareo-siliceous beds, quite fossiliferous at top, and at several horizons, the whole representing the **Stormville shales** of Monroe	150

[16] I. C. White, Report G6, Second Geological Survey of Pennsylvania, pp. 127-129; 1882.

	Feet.
3. **Limestone,** massive, cherty, siliceous, very fossiliferous, **Pentamerus galeatus,** being most abundant	10
4. Shaly, calcareo-siliceous beds, mostly concealed	75
5. Massive siliceous limestone	8
6. **Limestone,** massive, full of large **corals, Stromatopora** being very abundant	12
7. **Limestone,** blue, quarried, containing **Pentamerus galeatus,** and **Tentaculites gyracanthus**	12
8. Limestone, blackish, with concretionary nodules	13
9. Limestone, shaly, curly	15
10. **Water Lime** ("Pethstone" of Prof. Cook's section, Geology of New Jersey, pages 155-160)	5
11. Limestone, shaly, and gray at top, more compact and blue below, with concretionary nodules	12
12. Limestone, shaly, abounding in **fossil corals**	14
13. Limestone, gray, shaly, full of **crinoidal fragments** and **corals**	15
14. Shales, greenish, and shaly limestone	10
15. **Limestone,** massive, bluish-gray, containing numerous **crinoidal fragments, corals, etc., Chaetetes** being very abundant	10
16. Shales, calcareous, containing **Atrypa reticularis** and **Chaetetes**	2
17. Limestone, slaty fracture, non-fossiliferous, much resembling in physical characters the top of the **Bossardville limestone** of Monroe county	3
18. Concealed to probable base of **Lower Helderberg**	200
Total of Lower Helderberg beds	566
Total of Lower Helderberg beds and Oriskany	616

Generalized Section on the Delaware River.

	Feet.
1. **Oriskany sandstone,** consisting of alternating beds of quartz conglomerate, and calcareous chert	50

Lower Helderberg.

2. **Stormville calcareous shales,** ashy, or dark gray, fossiliferous, sometimes cherty and containing limestone at base	160
3. **Stormville conglomerate,** alternating beds of quartz conglomerate, and siliceous pebbly limestone	25
4. **Stormville limestone,** cherty, sandy, massive beds, containing numerous **fossils, Pentamerus galeatus, Stromatopora, Favosites,** and **Receptaculites** being especially numerous	75
5. **Hydraulic cement** bed ("Pethstone" of Cook) and identical with No. 10 of the preceding section	5
6. Limestone, bluish, shaly, containing vast numbers of **Leperditia alta,** at top	20
7. **Decker's Ferry sandstone,** a very hard, pebbly, often calcareous sandstone, filled with **fossil shells, Aviculas, Chonetes,** and others.	15
8. **Greenish shales,** sometimes calcareo-siliceous	15
9. **Bossardville limestone,** divisible into two well-marked sub-	

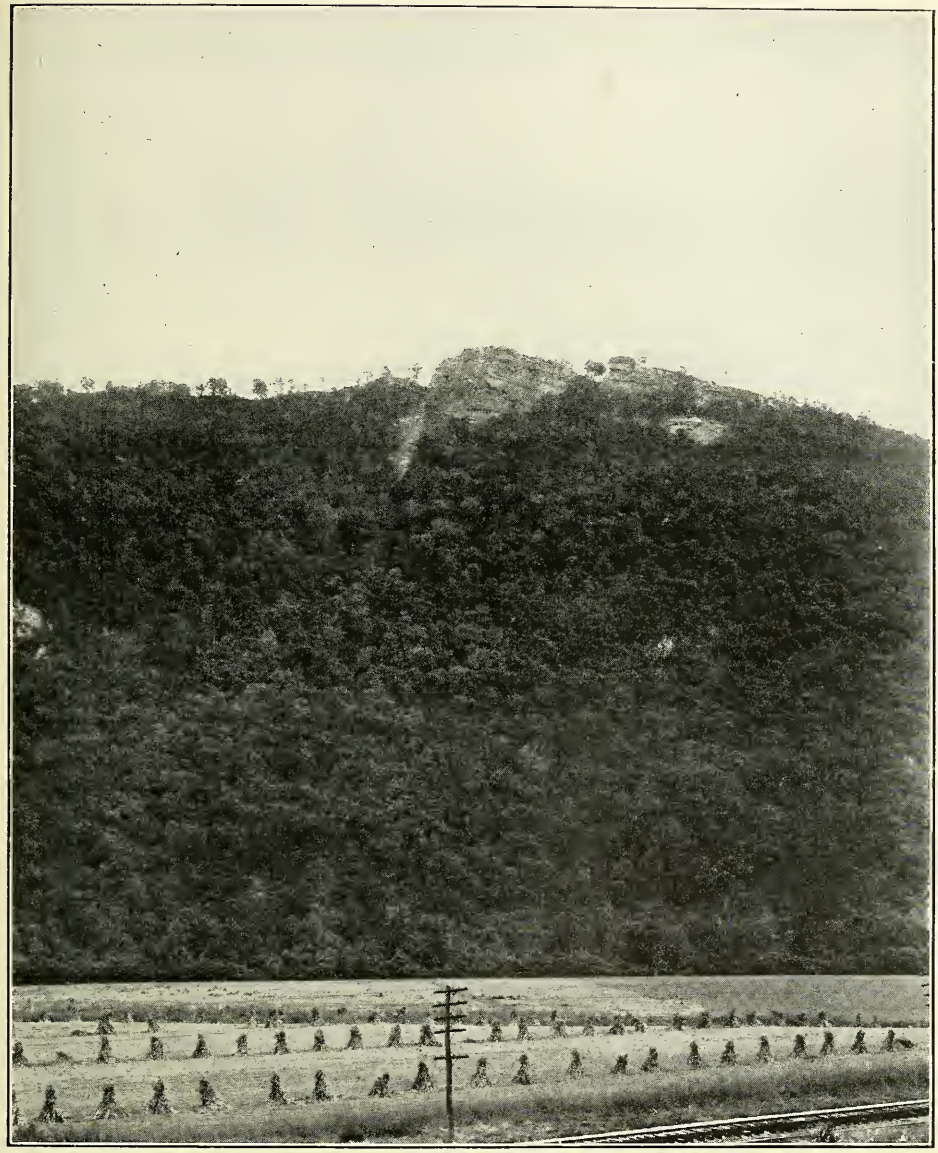

Photo by E. E. HARRIS.

PLATE XX.—View of Rock Hill northeast of Keyser showing cliff of New Scotland Chert at top. Steep slope below is principally Helderberg Limestone. North Branch of Potomac River at foot of hill is entirely concealed by foliage.

	Feet.
divisions, (a) of 65′ and (b) of 25′; the upper (a) almost non-fossiliferous, dark blue, or almost black, splitting into slate-like, thin layers; the lower, (b), dark-gray, always presenting a banded or striped appearance, and often exhibiting a true **columnar structure (Stylolites)**; thickness of both a and b	90
10. **Poxono Island shales,** buff, calcareous and magnesian	200
11. **Poxono Island limestone,** bluish-gray, very compact, fossiliferous, extending down to the bottom of the Lower Helderberg on top of the **Clinton red beds**	5
Total of Lower Helderberg	610
Lower Helderberg and Oriskany	660

It will be noted in the above sections that the Lower Helderberg was made to include everything from the Oriskany down to the top of the Clinton, such usage having been more or less common at this early date. In the Nearpass Quarry Section, which is described as being 1½ miles south of the Delaware River and 4 miles southeast of Carpenter's Point, Monroe County, No. 7 is evidently much the same as the Coeymans Member of the Helderberg and if that be true the presence of **Tentaculites gyracanthus** at such a high level is worthy of note. Regarding the Water Lime, No. 10, Dr. White (page 137) correlates it with the Rondout and Rosendale beds of New York but in a recent interview has expressed his belief that it is merely a recurrence of cement beds at an upper level, as it appears to be far above the true Rondout.

In the Delaware River Section, which is described as being in eastern Monroe County and partly generalized, No. 6 is the limestone that he later (page 137) names as the **Decker Ferry Limestone,** there being frequent references to the great number of **Leperditia alta** contained in it. An important correction in this section is made by Dr. White in Report G7, page 109, where he states that the beds termed Clinton at the base belong to the Bloomsburg Red Shale (Lower Salina) of Columbia County. That being the case the identity of the Poxono Island Shales and Limestone with the Rondout Waterlime becomes apparent.

Passing farther southwest the same author[17] in describing the Bossardville Limestone states that it contains **Leperditia alta** but is otherwise devoid of fossils, and in the same

[17] I. C. White, Wyoming, Lackawanna, Luzerne, Columbia, Montour and Northumberland Counties, Report G7, Second Geological Survey of Pennsylvania, p. 98; 1883.

volume (pages 103-106) describes the Upper Salina as containing much magnesian limestone and limy shales, totalling 329 feet on Big Fishing Creek.

In a later report on Huntingdon County farther west, Dr. White[18] summarizes the Salina beds as follows:

The Onondaga (Salina) Formation, No. Vb.

Upper; buff-colored, magnesian limestone	375′ to 450′
Middle; green shale and shaly limestone	400′ to 500′
Lower; (Bloomsburg) red shales	200′

"These 1050′ to 1150′ of beds like the 330′+410′+440′=1180′ of similar beds in Columbia County, represent the three divisions of the formation in middle New York State, but without gypsum and salt; as shown in Report G7."

Above the Onondaga (Salina) as above described there is a limestone classified as the **Lewistown** (page 123), varying in thickness from 351 to 393 feet, and containing fossils that indicate its Helderberg age. It is thus apparent that the upper Salina as therein classified occupies the position of his Bossardville in more eastern reports, but it is not described as such and the presence of **Leperditia alta** is not noted. The significant fact in this region, however, is the thickness of the combined Devonian and Silurian limestones, 1200 to 1400 feet, and approximating their development on the Potomac River.

Southwestward from the above region, Dr. Jno. J. Stevenson[19] gives the following summary of the **Lower Helderberg Limestone** in Bedford County near the Maryland Line:

VIc. Limestones, mostly massive (Lewistown Limestone)	336′
VIb. Limestones, flaggy, cement beds	283
VIa. Shales and thin irregular limestones	628
	1247

These beds are described as coming just under the Oriskany and the Lewistown evidently correlates with the present Helderberg, as the fossils in the context indicate. Speaking of VIb and VIa Dr. Stevenson (pages 88-89) says:

"The **middle division VIb** represents the **Tentaculite limestone of** New York, which is perhaps the upper division of the **Waterlime.** It is nowhere exposed in detail, but it consists mainly of blue to very dark blue flaggy to slaty limestones, mostly non-fossiliferous. The darker limestones are fetid when struck and ring sharply. Some reddish beds near the middle of the mass are not flaggy but thick-

[18] I. C. White, Report T3, Second Geological Survey of Pennsylvania, p. 128; 1885.

[19] J. J. Stevenson, Report T2, Second Geological Survey of Pennsylvania, pp. 87-88; 1882.

bedded. Partial exposures of this division were seen at Hyndman and elsewhere along the west foot of Will's mountain; a very fair exposure was found in Cumberland Valley township of Bedford county, where the thickness as given was measured. An imperfect exposure was seen on the Bedford and Chambersburg pike west from Everett, and another, farther north, on Piper's run. No good exposure was found in Fulton county. **Leperditia alta** and **Holopaea antiqua** were seen on Piper's run; **Beyrichia, Spirorbis, Leperditia alta, Spirifer vanuxemi,** and **Megambonia aviculoidea** were seen in Bedford borough. All of these forms are characteristic of the Tentaculite limestone.

"The **lower division VIa** consists of drab to reddish calcareous shales with thin streaks of limestone. The Cumberland road south from Bedford lies for most of the distance on this division. Imperfect exposures were seen on the Bedford and Chambersburg pike in Black valley, as well as at many localities farther south in that valley. This division is fairly well shown in Fulton county near Fort Littleton, and it is the immediately underlying rock of Pigeon Cove in that county. Toward the bottom it contains an irregular and impure limestone, which is quarried for agricultural uses at some localities. The only fossil seen is **Leperditia.**"

In Maryland no state-wide study of the Silurian has yet been published* but Stose and Swartz[20] indicate the following succession in descending order in the Pawpaw-Hancock region, partly in Maryland and partly in West Virginia, starting with an unconformity at the base of the Oriskany:

	Feet.
Helderberg Limestone	270-380
Tonoloway Limestone	400
Wills Creek Shale (Bloomsburg Red Sandstone Member 60′ thick at base of formation)	445
McKenzie Formation (Keefer Sandstone Member 40′ thick at base of formation)	170-300
Clinton Shale	.....

The Helderberg Limestone is there typical of the Potomac phase and contains some fossils not usually found in the New York sections, among which a late mutation of **Tentaculites gyracanthus** is mentioned by Ulrich who appears to have been consulted. Speaking of the Tonoloway Ulrich says:

"As a whole, the Tonoloway limestone of this region is very sparingly fossiliferous. Some layers, however, are crowded with organic remains, while here and there a **Stromatopora** reef may be encountered. Such a reef was noted 280 feet beneath the top of the formation in the Grasshopper Run section. The fossils usually seen are ostracods, species of **Leperditia, Kloedenia,** and **Kloedenella** being

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* The Silurian volume is now available. It puts the Keefer Sandstone in the Rochester formation of the Clinton Group instead of in the McKenzie.

[20] G. W. Stose and C. K. Swartz, Pawpaw-Hancock Folio, No. 179; 1912.

especially abundant. Locally the ostracods are associated with numerous **Tentaculites gyracanthus,** while several small brachiopods and a few slender branching Bryozoa occur more rarely. Farther west, between Cumberland, Md., and Keyser, W. Va., where the beds are better exposed and have been more carefully searched, a larger fauna has been found. There, as in the vicinity of Hancock, the respective faunas of the lower and upper portions are largely distinct. This will be apparent from the following two partial lists of species:

"Partial list of fossils from the lower portion of the Tonoloway limestone.

Stromatopora sp. undet.
Favosites globuliformis.
Fistuliporella, thinly lamellose species.
Cyphotrypa, new lamellate species.
Orthopora n. sp. (cf. O. regularis).
Schuchertella hydraulica var.
Meristella bella?
Whitfieldella nucleolata.
Rhynchospira globosa.
Rhynchonella litchfieldensis.
Rhynchonella hydraulica ?
Rhynchonella? lamellata.
Hormotoma sp. undet. (resembles H. gracilis).
Tentaculites gyracanthus.
Calymene camerata.
Leperditia alta.
Leperditia altoides (?).
Beyrichia n. sp. (resembles Entomis flabellifer and E. oblonga).
Kloedenia n. sp.
Bollia (? Halliella) n. sp. (reticulated surface, loop obsolete).
Kloedenella clarkei.
Kloedenella halli.
Kloedenella (? Tetradella) cf. hieroglyphica (Krause).

"Fossils from the upper 50 feet of the Tonoloway limestone.

Strophеodonta bipartita.
Spirifer corallinensis.
Spirifer eriensis.
Tentaculites gyracanthus.
Kloedenia cf. nearpassi.
Kloedenia sussexensis var.
Halliella ? cf. seminulum.
Primitia humilis ?
Kloedenella clarkei.
Kloedenella (? Tetradella) hieroglyphica.
Octonaria n. sp.
Bythocypris cf. concinna.

"Comparison of these faunas with the New York section leaves little doubt concerning the late Cayuga age of the formation. Most of the diagnostic species above listed occur in the Schoharie Valley sections in New York between the base of the Cobleskill and the top of the 'Tentaculite', or typical Manlius limestone. A considerable part of these species, it is true, passes upward in the Maryland sections into the Helderberg limestone. Noting their presence in the latter but disregarding the composition of the Tonoloway fauna, especially of its lower beds whose fossils are most like the Cobleskill, geologists who have studied the sections in the Potomac Valley have generally drawn the base of the formation which they correlated with the Cobleskill and Manlius rocks above the top of the Tonoloway. Recent field studies seem to establish that the typical Manlius limestone of New York is older than the base of the rocks here referred to the Helderberg limestone. The Manlius and Cobleskill therefore seem to be in general correlatable with the Tonoloway, although the fauna indicates that Tonoloway sedimentation in Maryland in part preceded that of the Manlius and Cobleskill in New York."

Discussing the Wills Creek Shale the authors say:

"Fossils are not plentiful in the Wills Creek Shale of this area, but those that do occur are conclusive as to age. The red and green sandstone and mud rocks at the base are barren of fossil remains and their general character resembles the barren red gypsiferous shale of the Salina of New York. The pseudomorphs of salt crystals here also indicate somewhat similar conditions of sedimentation to the salt beds of that formation. The calcareous shale and thin limestone beds contain chiefly ostracods—**Leperditia alta, Leperditia** sp. undet., **Kloedenella** cf. **clarkei,** and undescribed species of **Primitia, Ulrichia,** and **Kloedenia**—and a few undetermined pelecypods. Ulrich states that 'So far as known the fauna of the Wills Creek is intermediate in character between that of the underlying McKenzie and the overlying Tonoloway, the presence of species of **Leperditia** suggesting the latter formation while some of the smaller ostracods are closely allied to species abundantly preserved in the McKenzie. No exactly corresponding marine fauna is known in America, and the eurypterids have not been found in the Wills Creek. Nevertheless this formation is assigned to the age of the Salina of New York on the assumption that it represents shallow marine conditions prevailing in the Appalachian Valley region while more confined salt-pan conditions existed in western New York'."

Dr. Grimsley[21] has studied the same beds in three eastern counties of the State but does not enter into the fossil content of the Salina other than to quote from the pawpaw-Hancock Folio and other publications. He points out, however, that the McKenzie is of Niagara age, as determined by Prouty, and he adopts the formation names used on the first page of this present Chapter.

We have now followed the formations lying between the Oriskany and Clinton from Ulster County, New York, northwestward to Livingston County, then southwestward into northeastern Pennsylvania and westward to the central portion of that State, then southward to the Maryland State Line and to the Potomac River farther east. It has been shown first that the thickness of the beds has increased more than fourfold between the two fixed planes of reference and in consequence it must be apparent that lithologic members and faunal zones have greatly expanded. It has also been shown that at Rondout, Ulster County, there is a zone of **Leperditia alta** coming between the Helderberg and Rondout Waterlime Formations, its correlation as the Tentaculite or Manlius at that point being established. In western New York and northeastern Pennsylvania the Rondout is not distinguishable in the shaly beds but the **Leperditia alta** zone is found in all the Pennsylvania citations except Huntingdon

[21]G. P. Grimsley, Jefferson-Berkeley-Morgan Report, W. Va. Geological Survey, pp. 241-251; 1916

County and it is present along the Potomac River, coming in the next formation below the Helderberg at all localities but never reaching up into this limestone. On the Delaware River it is characteristic of the Decker Ferry and in counties farther west it is described from the Bossardville, the Decker Ferry not being recognized, and it is also occasionally reported from the lower formations.

The correlation of the Potomac phase of these formations with that of New York State has in the past been mainly attempted by a more southern route through New Jersey and has resulted in disagreement, even the relative positions of the Manlius, Decker Ferry, and Rondout being disputed. In choosing more northern exposures the writer has attempted to gather evidence from new sources so that an independent check of the formations may be available. Although handicapped by the necessity of drawing a conclusion from the field work of others, there is a compensating value in the fact that without exception the sections and data selected are the work of observers whose ability and experience can not be questioned.

It has been pointed out that in western New York both the Helderberg and Manlius are quite thin and that the Rondout can be scarcely recognized at the Livonia Shaft. In eastern Pennsylvania there is more Helderberg and below it, as shown by Dr. White's sections, the calcareous beds are greatly increased. His Decker Ferry Limestone appears to be near the top of the New York Manlius and his Bossardville also appears to be of much the same age, **Leperditia alta** being found in it farther southwest, but probably also represents the Rondout in part. Westward in Huntingdon County a significant thickening has taken place in the Salina, the upper division evidently representing the combined Decker Ferry Limestone, Decker Ferry Sandstone (which has been replaced by lime) and Bossardville Limestone, and being in general an expanded representative of the New York Manlius or Tentaculite. The Middle Division occupies the place of the New York Rondout with a thickness that has also greatly increased. In proof of such an interpretation Dr. Stevenson's description of the beds in Bedford and Fulton Counties is conclusive as to the Manlius or Tentaculite which is represented by his VIb formation and just below it the Rondout beds are indicated in VIa. These lower beds have been extensively mined for natural cement along the Potomac and their relationship to the Niagara is the same as at Rondout, New York, except that red shale comes between them as is frequently the case in many regions.

From the above evidence it is believed that the usage of Dr. Grimsley in the Jefferson, Berkeley, and Morgan Report in eastern West Virginia in assigning the title of **Bossardville Limestone** to the beds just below the Helderberg Limestone is quite proper. This formation on the Potomac evidently includes the Decker Ferry stage but there exists no way by which the two may be separated. His usage of the **Rondout Waterlime** as embracing the calcareous beds between the Bossardville and Bloomsburg is also accepted, although it may, and probably does, include the New York Cobleskill, Rosendale, and Wilbur, but there is no possibility of separating these units on the Potomac. It is further apparent that the Bossardville is much the same as the Tonoloway of the Pawpaw-Hancock Folio, as has already been indicated by Dr. Swartz in the Maryland volume on the Lower Devonian, and it is also evident that the Rondout comprises the calcareous or upper portion of the Wills Creek Shale of the same folio.

The propriety of including the Bossardville and Rondout under the Salina Formation, as is done by Grimsley, may be questioned and their affinities in this respect are obscure. The Eurypterids which characterize the Onondaga Salt Group or Salina of New York State appear to be largely absent in Pennsylvania, Maryland, and West Virginia*, and in the latter two States rock salt and gypsum are not encountered but pseudomorphs of salt crystals are reported in the red beds below the Rondout. In western Pennsylvania and eastern Ohio, however, rock salt in abundance has been found in deep oil wells at intervals of 300 to 600 feet below the base of the Oriskany Sandstone and quite evidently not far below the base of the Helderberg so that the Silurian saline conditions may not have accorded with time boundaries of sedimentation as is attested by their varied interpretation in New York, New Jersey, and Pennsylvania. The usage of Dr. Grimsley in this respect has been followed in the present Report, since there is no proof that it is wrong.

At the Devonian-Silurian boundary there remain to be considered the occurrence of fossils in the Keyser Member of the Helderberg similar to those in the Manlius, Rondout, and Decker Ferry, as has been pointed out by Dr. Swartz in the Maryland Volume on Lower Devonian wherein a cor-

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*Eurypterids have recently been reported from Keyser.—I. C. W. **Eurypterus flintstonensis** is lately reported 199 feet above the base of the **Tonoloway** (Bossardville) on Martin Mountain, Maryland, in the lately published Silurian Volume of the Maryland Geological Survey, page 143.—D. B. R.

relation with these beds has been suggested. Regarding the Decker Ferry, it has been shown in the present Report that it is mainly characterized on the Delaware River by vast numbers of **Leperditia alta** which together with **Tentaculites gyracanthus** are the guide fossils of the Manlius or Tentaculite Limestone and it has also been shown that **L. alta** has never been found in the Helderberg so that there is strong reason to believe that the top of the Decker Ferry marks almost the end of Manlius time and further that Manlius time in large part extends downward toward the base of the Bossardville. It has also been shown that the Rondout at its typical locality in Ulster County, New York, lies below the Manlius and as the latter is largely contemporaneous with the expanded Bossardville of Pennsylvania and the Potomac Valley, the Rondout must therefore lie below the Bossardville (Tonoloway) on the Potomac and must correspond with the flaggy cement beds of that region which are called Rondout in this Report and in the Jefferson, Berkeley, and Morgan Report of the West Virginia Survey, but which are plainly the calcareous upper portion of the Wills Creek Shale of the Pawpaw-Hancock Folio and of the Maryland volume on Lower Devonian.

It is quite true, as Dr. Swartz has shown, that some of the Decker Ferry and Manlius fossils are found in the Keyser Member of the Helderberg and that several of these have not been reported in the New York phase of the latter. Weller has also shown, however, that the Decker Ferry contains several forms that are common in the Coralline Limestone, as well as some species that are closely related to the Helderberg, his conclusion being that the fauna is Silurian and that it is probably contemporaneous with some portion or all of the Niagaran of the interior.[22] Between these extreme views on the Decker Ferry the truth probably lies. It may well be the case that in the westward expansion of the Helderberg new zones may have appeared containing fossils not to be found in New York, an instance being the **Tentaculites gyracanthus** of the Nearpass Section which is clearly in the Helderberg, and the researches of J. B. Reeside, Jr., as published in Professional Paper No. 108, pages 185-226, of the United States Geological Survey, reveal the presence of the Keyser fauna in the thick Helderberg of central Pennsylvania. In nearly all of the Decker Ferry fossils there is a surprising stratigraphic range both downward and upward, the most

[22]S. Weller, Paleontology of New Jersey, Volume III, pp. 62-76; 1903.

conspicuous exception being **Leperditia alta** which ranges downward through most of the Salina but never seems to be found above the horizon of the "Pethstone" lying just on top of the Decker Ferry at the Nearpass Section and there containing this fossil as shown by Weller.[23] It would appear, therefore, that **Leperditia alta,** which is so characteristic of the Salina, may be the guide fossil by which the upper limit of Silurian Rocks can be traced from New York and New Jersey across Pennsylvania into the Potomac region of Maryland and West Virginia.

In the above review of the Devonian-Silurian contact no allusion has been made to the faunal content of the Bossardville and Rondout Limestones in Mineral and Grant Counties, as it is desired to present all such data under the description of these beds on subsequent pages.

BOSSARDVILLE LIMESTONE.

GENERAL ACCOUNT, BOSSARDVILLE LIMESTONE.

The Bossardville Limestone is the highest formation of the Silurian Rocks of the two counties as herein correlated. It is gray, flaggy, and usually compact, but sometimes contains more shaly layers although non-calcareous or sandy beds are entirely lacking. A very noticeable feature is its angular cleavage into geometric figures, few of which are rectangular, the more common forms being triangular, trapezoidal, or rhomboidal. In chemical quality it usually contains small quantities of silica and alumina and a variable amount of magnesium carbonate which is much less than the amount called for in a theoretical dolomite. Its thickness in the two counties varies from 200 to 400 feet. In Chapter V it is recorded as 463 feet in the Cedar Cliff Section and 234 feet in the Limestone Run Section and at the Potomac Section the combined Bossardville and Rondout measure 860 feet, all of these localities being along North Branch of Potomac River. In Grant County there is 210 feet of it visible at the Falls Section but it is probable that some concealed strata included in the Helderberg may belong to the Bossardville. In the Maysville Section its contact with the Rondout was not differentiated but it appears to be approximately 400 feet thick.

The time and lithological affinities of the Bossardville with the formations of eastern States has already been discussed in the Introduction to this Chapter, the conclusion

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[23]Ibid, pp. 76-77.

being that it probably correlates with the Manlius and Decker Ferry of New York and New Jersey and that it is practically the same as the Tonoloway of Maryland. It is quite true that the original designation of the Bossardville in Pike and Monroe Counties of Pennsylvania by Dr. I. C. White in his Report G6 for the Second Geological Survey of that State did not include the Decker Ferry beds, these being differentiated from the underlying Bossardville by easily recognized lithologic features, including a sandstone, but it has been pointed out in preceding pages of this Chapter that these lithological peculiarities disappear entirely in approaching the Potomac territory, the strata being uniformly calcareous from the Rondout up to the base of the Helderberg. At the type localities, however, the fossil content of the Bossardville and Decker Ferry is continuous and the same fauna extends up into the New Jersey Pethstone where it suddenly stops. Such being the case all the beds between the Helderberg and Rondout, have been assigned to the Bossardville as an inclusive term, no further separation being practicable.

TOPOGRAPHIC EXPRESSION, BOSSARDVILLE LIMESTONE.

Being located between two other heavy limestone formations, the Bossardville makes no complete topographic forms in either county. It is found almost entirely on the slopes of the major anticlines where it is protected, together with the Helderberg and Rondout, by the more resistant rocks coming above and at some distance below this calcareous stage. Along North Branch of Potomac these three limestones make enormous cliffs protected from erosion by the Oriskany Sandstone and New Scotland Chert on the ridges, and the same condition is apparent to a less degree along South Branch of Potomac in the Smokehole Settlement of Grant County.

AREAL EXTENT, BOSSARDVILLE LIMESTONE.

In Mineral County, as shown by Map II, the Bossardville Limestone does not outcrop east of Knobly Mountain but along the western side of this ridge, starting in the vicinity of Cumberland and Ridgeley, there is a long exposure entirely across the county, its position just southwest of Ridgeley being in the plain at the foot of the mountain and therefore largely covered by alluvium but in the neighborhood of Cedar Cliff, Seymour, and the Baltimore and Ohio Railroad tunnel it is well exposed in the mountain cliffs, being on the eastern side of the Wills Mountain Anticline. In the region one mile southeast of Lowndes the topographic and structural

arrangement is such that the Bossardville outcrop occupies the crest of the anticline and one limb of it passes northeastward to the Maryland Line on the western side of the arch, being visible in the Baltimore and Ohio cut east of Potomac Station. From the locality mentioned southeast of Lowndes the outcrop continues on the summit of the anticline southwestward to a point just north of O'Neil Gap, about 2½ miles northeast of Keyser, where the rising structure brings older rocks to the surface, making the Bossardville divide the eastern limb passing through the sinks southwest of O'Neil Gap and lying just east of the reservoir at the head of Limestone Run. Beyond the reservoir it continues on the western side of Knobly Mountain, making a large sink-hole 1½ miles southwest of Antioch and reaching the Grant County Line about one mile northwest of Whip Gap. The limb which branches off to the western side of the Wills Mountain Anticline near O'Neil Gap passes southwestward to the quarries of the Standard Lime and Stone Company east of the mouth of Limestone Run, being a portion of the rock which is there excavated, and thence crosses Limestone Run and continues southward in the low gaps lying between Abrams Ridge and New Creek Mountain but in the gap one mile southeastward from New Creek village the alignment of New Creek Mountain and the rise of the structure is such that this limestone passes to the western side of the mountain and its narrow outcrop continues on to the region one-half mile southeast of Claysville where it is forced farther west by the beginning of the Laurel Dale Anticline so that from a point 1.3 miles southwest of Claysville it roughly coincides with the valley of New Creek, the public road at the Grant County Line being on its outcrop. Along North Branch of Potomac there is a further outcrop of the Bossardville on either side of the Noswad Anticline for the greater part of its length in Mineral County, and along either side of the Fort Hill Anticline there is another outcrop from the river southward nearly to Rock Hill where it passes under younger strata.

In Grant County, as shown by Map IV, the Bossardville is uncovered by erosion along the crest of the Patterson Creek Mountain Anticline one-half mile southward from Twin Mountain village, there being from this locality a belt passing southward on the eastern side of the anticline to the low gap 1.4 miles southeast of Williamsport. Beyond this low gap it soon passes into Hardy County. The limb which follows southward along the western slope of the Patterson Creek Mountain fold crosses the public road about one-half mile east of Williamsport, being there quite well exposed, and

continues with the slope of the mountain, being just west of the big sink along the road which crosses from Forman toward Hardy County, and being visible from 1 to 1.3 miles east of the Frye School on the next road which crosses the mountain. South of this locality the structure declines, causing the Bossardville outcrop to approach the crest of the anticline and mountain and to coincide with both in the Charles Knob, south of which it is covered by younger rocks along this fold, except in the gap made by South Branch of Potomac through the mountain where there is a small area of Bossardville just west of Welton along the axis of the Welton Anticline.

In the Elkhorn Mountain country there is an outcrop of Bossardville on the western slope of the Elkhorn Mountain Anticline starting at the Hardy County Line 1 mile northwest of Elkhorn Rock, passing just east of Cedar Knob, just east of Getz School, and just east of Bergdoll School. About one mile southeast of this point the southward dip of the structure carries the Bossardville to the axis of the arch and a limb of it circles around to the eastern slope and northeastward to the Hardy County Line one-half mile southwest of Ketterman School, while the main outcrop follows the anticline southward to the Pendleton County Line just east of Spring Mountain, there being two localities where the drainage has cut down into the Rondout.

West of the two general areas described the Bossardville is below drainage in a wide belt embraced by the depressions of the Bedford, Middle Mountain, and other synclines, but on the western slope of Knobly its outcrop enters Grant County one mile north of Whip Gap and passes southwestward, being exposed just west of Whip Gap and Harris Gap and crossing North Fork of Patterson Creek about three-fourths mile northwest of Falls, Lunice Creek one-half mile west of Maysville, South Fork of Lunice Creek in Real Gap at the mouth of Bodkins Run, is well exhibited in the western end of Robinson Gap and crosses North Fork of South Branch 1.2 miles southwest of Corners. South of this point its same relationship to the string of knobs that represent the further extension of Knobly Mountain continues, its outcrop being just west of Redman Gap and Shirk Gap in the Smokehole Settlement and finally reaching the Pendleton County Line about three-fourths mile northwest of Ketterman.

In the Smokehole Settlement there is an additional outcrop of Bossardville starting on South Branch about one-third mile southeast of Shirk Gap and occupying the lower portion of the valley in the vicinity of Blue Rock. The Blue

Rock, which appears to be Bossardville, is an isolated shaft of grayish-blue limestone, about 15 feet thick and possibly 150 to 200 feet high, its third dimension being indefinite but probably the largest of all because it sticks into the mountain and preserves the equilibrium of the mass. At present the dip of this enormous flagstone, if it may be so called, is northwestward about 75° and it would appear to have been split from the parent formation by the same force which developed the large overthrust fault which is conspicuous near the Pendleton County Line (see page 130), and with which the Blue Rock is in approximate line, although it has not been possible to trace the fault this far northward. This rock is located about 0.2 mile east of the Blue Rock Syncline and just north of the mouth of a small stream which enters South Branch from the east and the normal dip should be westward and the rise should be eastward toward the Cave Mountain Anticline but the pitch of this flagstone is entirely too great to be in harmony with the structure so that the effect of faulting is evident.

Just east of the Blue Rock the outcrop of Bossardville divides, the western branch extending southward with the middle slope of the west side of Cave Mountain through Shoock Gap and thence across a bend of South Branch just beyond which it disappears from view, being on the under side of the overthrust fault mentioned above. The eastern limb passes northeastward from Blue Rock to a low gap in Cave Mountain and thence turns southward and in the main coincides with the summit of the mountain almost to the Pendleton County Line where it is slightly west of the top.

West of New Creek Mountain and the Wills Mountain Anticline the Bossardville outcrop enters Grant County from Mineral with the county road just northeast of Kittlelick Ridge and closely follows the New Creek Valley southward to Mountain Valley School and then is found on the eastern side of Walker Ridge all the way to North Fork of Patterson Creek which it crosses 0.3 mile southwest of Greenland, there being another small, isolated exposure where a minor anticline crosses the same creek 0.7 mile southwest of Greenland. South of North Fork of Patterson Creek the main outcrop stays on the eastern slope of the string of hills which are the southern extension of Walker Ridge, crossing Lunice Creek 0.1 mile east of Brick Church and South Fork of Lunice Creek 0.2 mile east of Streby, and thence on to the headwaters of Jordan Run, its position being in general about one-half mile east of this stream except in the last mile of its lower course where the run turns more toward the east

so that the Bossardville crosses North Fork of South Branch of Potomac River about 0.2 mile east of the mouth of Jordan Run. Beyond North Fork the outcrop continues along the western lower slope of North Fork Mountain, and crosses the Pendleton County Line about 1.1 miles southeast of the mouth of Mill Run.

CONTACTS, BOSSARDVILLE LIMESTONE.

The upper contact of the Bossardville Limestone with the Helderberg of the Devonian has already been discussed under the latter member, page 344, the greater number and variety of fossils in the Helderberg as compared to the Bossardville being mentioned, together with the existence of a prominent Stromatopora reef at this horizon, and a change from flaggy limestone in the Bossardville to more massive beds in the Helderberg. Its basal contact with the Rondout Waterlime is much less distinct. The Rondout is darker and the flags are usually much thinner and as a rule it is harder, although this is not always the case. Both of these limestones are almost completely barren of fossils but when there is a fauna it is much the same in both so that there is no certain paleontologic guide to the contact. The range of the same species through both formations indicates that there is no appreciable lapse of time nor is there any noticeable lithological unconformity. Such being the case the delimitation of this boundary is often uncertain.

FOSSIL LIFE, BOSSARDVILLE LIMESTONE.

In the Bossardville Limestone a general scarcity of fossils has already been mentioned. Some collections, however, were made by Scheffel and Price, the identifications of which by Dr. Prouty will be found in Chapter XXI. These lists reveal a somewhat varied fauna of ostracods, pelecypods, brachiopods, gastropods, and other forms, among which a fragment of a Eurypterid carapace found between the twin quarries just east of Keyser is of interest because it to some slight extent suggests an affinity with the New York Salina Beds. The age of all these collections is assigned by Dr. Prouty to the Tonoloway of the Pawpaw-Hancock Folio, the latter formation being described as in part contemporaneous with the Bossardville. Such being the case the retention of the earlier title in this Report appears justified.

The following is a summarized list of all fossils identified by Dr. Prouty from the Bossardville in the two counties, one collection from Allegany County, Maryland, being included:

Cf. Spirifer corallinensis Grabau
Hormatoma sp. very small
Leperditia alta Conrad
Leperditia alta var.
Leperditia mathewsi Ulrich and Bassler
Leperditia cf. mathewsi Ulrich and Bassler
Leperditia elongata close to var. willsensis Ulrich and Bassler
Leiopteria sp.
Cf. Welleria obliqua Ulrich and Bassler
Dizygopleura close to concentrica Ulrich and Bassler
Orthoceras sp. minute form about the size of a hair
Cf. Eurypterus sp. fragment of a carapace
Cf. Hindella congregata Swartz
Homeospira sp.
Cf. Schuchertella rugosa Swartz
Sphaerocystites sp.
Spirifer sp.
Spirifer vanuxemi Hall
Bryozoa sp.
Camarotoechia tonolowayensis Swartz
Modiolopsis leightoni Williams.

SUBDIVISIONS, BOSSARDVILLE LIMESTONE.

The Bossardville Limestone has not been subdivided into smaller units in the Mineral and Grant County area, there being insufficient evidence on which this may be done. Its lithologic character is much the same from top to bottom except that there is sometimes a tendency toward more shaly beds at the base. It is also so nearly barren of fossils that it does not appear possible to determine faunal zones that may be traced through different localities.

In the Introduction to this Chapter the statement has been made that the Bossardville as herein defined starts approximately with the horizon of the New Jersey Pethstone and includes the Decker Ferry beds below the Pethstone, and ends at the bottom with the base of the Bossardville as originally defined by Dr. White in Report G6 of the Second Geological Survey of Pennsylvania. The fact that the lithology typical of the Decker Ferry in eastern Pennsylvania does not extend westward to the Potomac River has already been mentioned together with the equally important presence of **Leperditia alta** in all the beds here described as included in the Bossardville. The affinity of its upper portion with the New York Manlius has also been indicated.

ECONOMIC ASPECTS, BOSSARDVILLE LIMESTONE.

Besides being a source of much good agricultural soil the Bossardville Limestone may be used for many commercial purposes. In most localities it is pure enough for agricultural lime and in some cases could be used in Portland cement. It is also of value for the inexhaustible quantity of

good crushed stone that may be quarried from it both for road material and general concrete work where fire resistance is not an item. All of these uses, together with its chemical quality and detailed quarry data, will be discussed in Chapter XVIII under the subject of "Limestone."

RONDOUT WATERLIME.

GENERAL ACCOUNT, RONDOUT WATERLIME.

The **Rondout Waterlime**, coming just under the Bossardville, includes the calcareous beds down to the top of the Bloomsburg Red Shale which is of common occurrence in both counties. It is usually dark-gray or grayish-blue, noncrystalline, flaggy, and quite hard, and nearly barren of fossils. It differs from the Bossardville in being darker, having thinner flags, and in being usually harder and its cleavage is inclined toward rectangular and prismatic figures. At Potomac Station where it has been mined for natural cement the latter are quite prominent in the old headings, indicating old mud-cracks which have been refilled with newer material of a slightly different color. An exactly similar occurrence of these mud-cracks, enclosing prismoidal blocks, is reported and well illustrated by Van Ingen and Clark[23] from the typical Rondout beds of New York State. Another feature of note in the Rondout is the "calico" weathering which appears on the surface of some of the flags. This peculiarity is well shown in the eastern quarry of the Standard Lime and Stone Company just east of Keyser where a great slab has impressed upon it wide bands of lighter color, enclosing roughly rectangular areas of darker material, and altogether much resembling a huge room and pillar coal mine map, as shown in an illustration in this Report.

The thickness of the Rondout varies from 200 to 400 feet or possibly more. In Chapter V it is recorded as 469 feet in the Cedar Cliff Section, its base not being quite exposed. In the Potomac Section the Bossardville and Rondout have a combined thickness of 860 feet, the contact not being determined and there being a further possibility of a duplication of beds in the latter. In the Limestone Run Section, near Keyser, there is a visible thickness of 292 feet, the basal portion being covered. In the Falls Section it totals 647 feet, but this figure is questionable as there was a large concealed interval in which dips could not be accurately deter-

[23] Gilbert Van Ingen and P. Edwin Clark, New York State Museum, Bulletin No. 69, pp. 1184-1185 and Plate 6 opp. p. 1186; 1903.

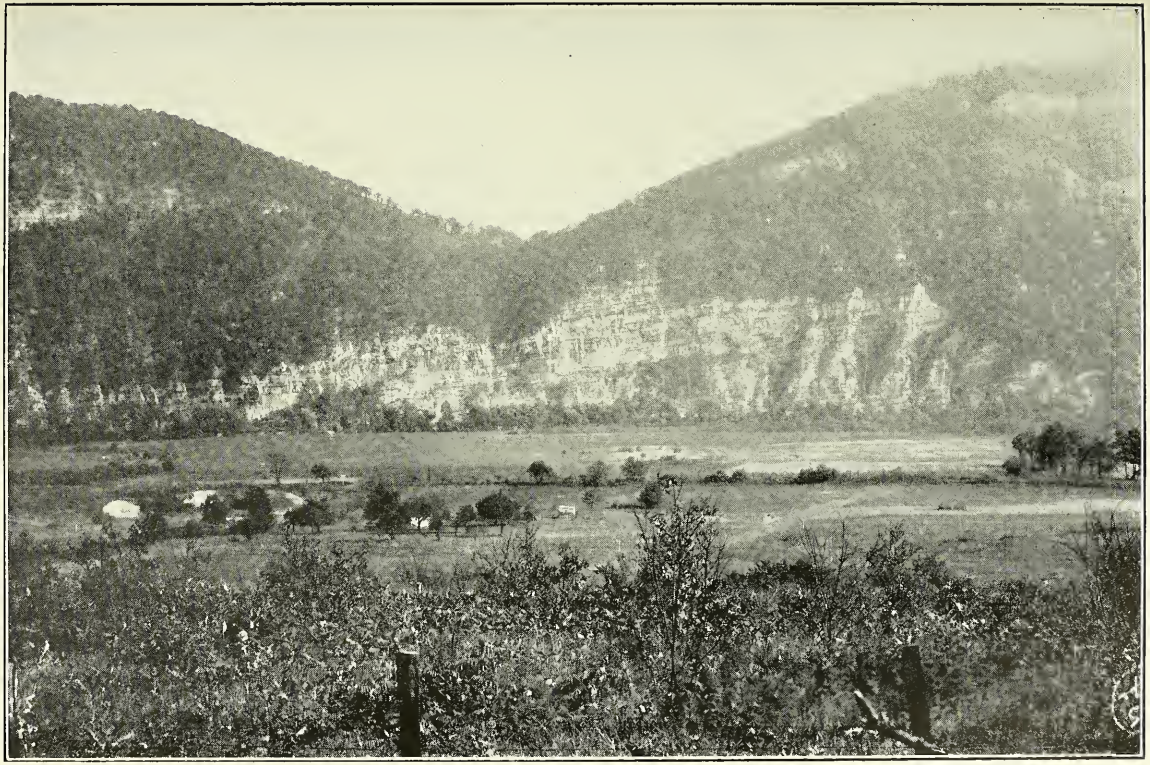

Photo by E. E. HARRIS.

PLATE XXI.—Helderberg, Bossardville, and Rondout Limestones in west side of Knobly Mountainn just northeast of Cedar Cliff. North Branch of Potomac River at foot of bluff is concealed by foliage. Immediate foreground is Clinton, followed by Niagara and Bloomsburg in flat land. See Cedar Cliff Section.

mined. In the Maysville Section the contact with the Bossardville could not be determined but there is certainly 323 feet of Rondout and possibly a little more. On Patterson Creek Mountain, 2 miles east of Forman, Grant County, it is well exposed in the public road at the south edge of a large sink, and at this point a measurement across the upturned edge of the strata which dip 25° northwestward shows a thickness of 323 feet. Here it is dark, hard, and flaggy, with a few small fossils near the base.

Besides being considered as the expanded equivalent of the Rondout of New York State, this formation appears to closely represent the Poxono Island Shales and Limestone of Monroe County, Pennsylvania, described by Dr. White in Report G6 of the Second Geological Survey of that State as being the lower beds of the Salina but later assigned by the same author (Report G7, page 109) to the middle Salina. This later interpretation, as elaborated by Dr. White, causes the heavy reds at the base of his "Generalized Section on the Delaware River" (republished on pages 368-9 of this Report) to belong to the Bloomsburg instead of the Clinton and would by implication place the Poxono Island strata at the Rondout stage.

In the Pawpaw-Hancock Folio of Stose and Swartz the calcareous upper portion of the Wills Creek Shale appears beyond little doubt to be the same as the Rondout as herein classified, the lower portion, or "Bloomsburg Red Sandstone Member" of that folio being the same as the Bloomsburg Red Shale as defined in the present Report.

TOPOGRAPHIC EXPRESSION, RONDOUT WATERLIME.

Being closely associated with the Bossardville and Helderberg Limestones, the Rondout makes no complete topographic forms, but in combination with the other two it is often found along steep mountain slopes where more resistant rocks form the main ridge. The three limestones are a noticeable feature in many large cliffs along North Branch of Potomac River between Cumberland and Keyser and they are also prominent in the Smokehole Settlement of Grant County. Along Patterson Creek Mountain between Twin Mountain and Charles Knob a considerable portion of the ridge is formed by the Rondout outcrop, but numerous gutters have been cut into it and one large sink has appeared, indicating comparatively rapid erosion.

AREAL EXTENT, RONDOUT WATERLIME.

In Mineral County, as shown by Map II, the Rondout Waterlime does not outcrop east of Knobly Mountain, since

the folds are not large enough to bring it to the surface. West of this mountain it enters the county 2 miles southwest of Cumberland but is mostly concealed for about one mile across the bend of North Branch. At Cedar Cliff and for one mile northward it is the lower part of the huge limestone cliff, but its base is not exposed above the river. Southwest of Cedar Cliff it forms the lower slope of the mountain but passes to the Maryland side of the river in the wide bend opposite the Baltimore and Ohio Railroad tunnel. One-half mile southwest of the tunnel it again enters West Virginia and its outcrop circles westward across the descending axis of the Wills Mountain Anticline and thence northward along the western flank of this fold to the river at the old cement mines about one-third mile east of Potomac Station, there being a good exposure on the Maryland side of the Potomac. From this locality southwestward for eight miles there are no further Rondout exposures along the Wills Mountain Anticline, there being a long, low saddle in this fold, but in the minor structures which occupy lower topography near the river and northwest of the main arch it outcrops in a narrow belt along the Noswad Anticline coming into the State about two miles southwest of Rawlings and remaining above the surface for nearly three miles to a point just east of Noswad. On the axis of the Fort Hill Anticline between Dawson and Gerstell, also, it is above drainage for about one-half mile south of the Potomac but is mostly concealed by Pleistocene and Recent material.

Near O'Neil Gap, 2½ miles northeast of Keyser, the Rondout again comes above the surface along the rising axis of the Wills Mountain Anticline which soon divides the outcrop into two narrow belts on either flank, that on the east following along the lower western slope of Knobly Mountain and passing through the reservoir at the head of Limestone Run and crossing the Northwestern Pike at the residence of D. A. Arnold at the road fork 1½ miles southeast of New Creek village. Beyond this point it occupies low ground between Knobly and New Creek Mountains all the way to the Grant County Line, being responsible for the western edge of the large sink-hole 1½ miles southwest of Antioch, most of this depression being Bossardville.

From O'Neil Gap the belt of Rondout on the western slope of the Wills Mountain Anticline passes southwestward through the eastern of the twin quarries of the Standard Lime and Stone Company about one mile east of Keyser, and thence crossing to the west side of Limestone Run occupies low ground at the eastern base of New Creek Mountain to

the gap one mile northeast of Claysville where the change in the alignment of the ridge, together with the rise of the anticlinal axis shifts it to the western slope of New Creek Mountain. Just southeast of Claysville the Laurel Dale Syncline and Laurel Dale Anticline interrupt the general slope of the strata so that the Rondout is found along the axis of the syncline to the Grant County Line and also on the western slope of the Laurel Dale Anticline just east of the road which follows New Creek to the county line.

In Grant County as shown by Map IV, the Rondout Waterlime appears above the surface along the axis of the Patterson Creek Mountain Anticline three-fourths mile southwest of Twin Mountain village and occupies the crest of the arch to the head of Long Hollow 2 miles east of Forman, except that in the heads of two deep ravines northeast and southeast of Williamsport, respectively, older formations are exposed by erosion, the Rondout being visible on either flank. From Long Hollow southward its outcrop crosses the Forman-Moorefield road at the large sink on top of the mountain, this depression being almost entirely Rondout, and then lies slightly west of the ridge and anticline for two miles, there being older formations along the crest, after which it partly coincides with the top of the mountain and partly lies east of it, finally disappearing from view under younger strata at the northern end of Charles Knob.

In southeastern Grant there is another strip of Rondout lying on the northwestern slope of the Elkhorn Mountain Anticline, starting at the Hardy County Line three-fourths mile northwest of Elkhorn Rock and extending southwestward across the headwaters of Spring Run and Long Run and crossing Rough Run about 1.3 miles southeast of Rough Run village. It then crosses Waterfall Run about 1.4 miles above its mouth and passes slightly east of Bergdoll School after which the descending axis of the anticline causes it to cross to the eastern flank of the fold and to extend northeastward to the Hardy County Line at the top of the mountain west of Ketterman School. Farther southwest along the anticline toward the Pendleton County Line, it is exposed at only two isolated localities where branches of Wolfpen Hollow have cut into it.

Farther west in Grant County the outcrop of Rondout which lies on the eastern side of the Wills Mountain Anticline crosses the Mineral-Grant Line about one mile northwest of Whip Gap and passing southwestward generally occupies low ground between Knobly and New Creek Mountains all the way to North Fork of South Branch of Potomac. In this

distance it crosses the headwaters of Whip Run and Rosser Run, crosses Thorn Run about 1.2 miles northwest of Martin, North Fork of Patterson Creek 0.8 mile northwest of Falls, Lunice Creek about the same distance west of Maysville, passes down the eastern side of Bodkins Run, crossing South Fork of Lunice Creek 0.6 mile west of Kline Gap School. Farther south it occupies the headwaters of Robinson Run west of Robinson Gap and reaches North Fork of South Branch 1½ miles southwest of Corners. From North Fork it extends on through the Smokehole Settlement, crossing Redman Run 0.8 mile above its mouth and then lying on the eastern side of this stream and on the eastern side of Long Run, and reaching the Pendleton County Line 1 mile northwest of Ketterman.

Along the Cave Mountain Anticline east of South Branch in the Smokehole Setlement there is another outcrop of Rondout, starting in the head of a deep ravine east of Blue Rock and passing southward along the western slope of the anticline for about one mile and then widening until it covers the whole arch northeast of Shoock Gap and also southeast of Shoock School, but along the axis northeast of the latter point a deep ravine cuts into older formations and in the vicinity of Ketterman School the outcrop is confined to a narrow belt lying between the anticline and Cave Mountain, the western limb having been covered by the overthrust fault which occurs near the Pendleton Line.

West of New Creek Mountain one narrow strip of Rondout crosses the Mineral-Grant Line coincident with the axis of the Laurel Dale Syncline and another lies between the Laurel Dale Anticline and New Creek. The former follows the axis of the syncline to the head of New Creek but the latter crosses to the western side of New Creek just south of Mountain Valley School and then follows the eastern slope of Walker Ridge to the head of New Creek where it joins with the other strip at the southern end of the two subsidiary folds mentioned. From the head of New Creek southward the outcrop is on either side of the county road for more than a mile, beyond which it lies west of the road and on the eastern side of Walker Ridge, crossing North Fork of Patterson Creek 0.3 mile southwest of Greenland. From this point the outcrop is narrow and almost straight, through low ground, to Lunice Creek at the road fork 0.2 mile southeast of Brick Church, and on to South Fork of Lunice Creek 0.3 mile southeast of Streby and thence continuing to the headwaters of Jordan Run where its position is about midway between the run and New Creek Moun-

tain. This relationship is preserved nearly to North Fork of South Branch of Potomac where the run turns slightly eastward and the Rondout outcrop occurs only 0.2 mile east of the mouth of this stream. Here is crosses North Fork and continues on to the Pendleton County Line, its position being on the western slope of North Fork Mountain about one mile from the top of the ridge and a slightly less distance east of North Fork.

CONTACTS, RONDOUT WATERLIME.

The contact of the Rondout Waterlime with the Bossardville Limestone above it has already been discussed, page 382, under the description of the latter formation, the absence of any very distinctive change being pointed out. At its base, however, the Rondout rests upon the red and green shales of the Bloomsburg Red Shale. Inasmuch as the latter formation is almost devoid of marine remains and from its lithology was evidently deposited in lagoons or shallow tidal basins, as will be later discussed, it is quite evident that a subsidence of some magnitude must have occurred before the calcareous sediments of the Rondout could have been formed, but if the Rondout be of Salina age as has been assumed by Dr. Grimsley and herein followed, whatever unconformity may exist must be due rather to a sudden diastrophic action than to an important and long-sustained time break.

In the Pawpaw-Hancock Folio, where the Rondout and Bloomsburg have together been assigned the title of "Wills Creek Shale" in the evident belief that no extensive unconformity exists between them and where pseudomorphs of salt crystals are reported from both, the quotation attributed to Ulrich and published on page 373 is of much interest on the age question.

The condition which prevailed during the Bloomsburg stage must have been that of a large tidal basin subject to constant loss of water through evaporation so that it often became too shallow or too thick with brine for marine life to flourish, while at the same time minor oscillations must have occasionally replenished the supply. When the Rondout stage began there was enough depression of the basin floor to make a fairly continuous connection with the outer Appalachian Sea and to reduce the salinity of the water to such an extent that restricted marine life was possible, but still subject to sporadic interruptions as witnessed by numerous mud-cracks. It thus appears that the change from Bloomsburg to Rondout was one of degree rather than that of long-prevailing inaction.

FOSSIL LIFE, RONDOUT WATERLIME.

The Rondout of the two counties is but sparingly fossiliferous. Some collections were made by Scheffel and Price, the identifications of which by Dr. Prouty are published in Chapter XXI. These lists reveal several species of ostracods, among which **Leperditia alta** is common, and undetermined bryozoa in great numbers are also found at one point. Other types are found in some localities but do not appear to recur with much regularity. Dr. Prouty has assigned these collections to the Wills Creek Shale of the Pawpaw-Hancock Folio, indicating a western continuity of the Wills Creek Shale beds in Mineral and Grant Counties, although, with the exception of the Bloomsburg portion, they have entirely turned to solid limestone. As previously stated the correlation of the calcareous part of the Wills Creek with the Rondout of New York has been indicated by Dr. Grimsley and in the Introduction to the present Chapter of this Report the reasons for such a classification have been elaborated.

The following is a summarized list of all fossils identified from the Rondout by Dr. Prouty in the two counties, three collections from Allegany County, Maryland, being included:

Leperditia alta (Conrad)
Leperditia altoides var. marylandica (Ulrich and Bassler)
Leperditia elongata var. willsensis
Leperditia elongata willsensis (Ulrich and Bassler)
Leperditia sp.
Kloedenia longula (Ulrich and Bassler)
Kloedenella close to gibberosa
Kloedenella close to subovata
Eukloedenella close to simplex
Zygobeyrichia incipiens (Ulrich and Bassler)
Camarotoechia close to C. andrewsi (Prouty)
Meristena sp. very small form
Beyrichia mesleri (Ulrich and Bassler)
Dizygopleura acuta (Ulrich and Bassler)
Dizygopleura close to swartzi
Bythocypris sp.
Leiopteria sp.
Dalmanella close to D. elegantula (Dalman)
Orbiculoidea ? sp.
Hormatoma sp.
Ramose bryozoa sp.
Fragment of smooth brachiopod sp. ?
Cf. Tetrameroceras something like T. Cumberlandicum (Swartz)

SUBDIVISIONS, RONDOUT WATERLIME.

Owing to the scarcity of marine remains and to the uniformity of its lithology, it has not been possible to divide the Rondout either into faunal zones or lithologic subdivisions. Farther east in the Pawpaw-Hancock territory a sandstone is reported by Stose and Swartz as occurring at the top of the

formation and the calcareous material which follows below is broken by interjections of variegated shale and sandstone, but these differences do not occur in Mineral and Grant Counties.

ECONOMIC ASPECTS, RONDOUT WATERLIME.

In addition to being the basis of good agricultural soil the Rondout Waterlime is fit for many of the commercial uses to which limestone may be put. Its hard and durable character makes it good material for road paving, ballast, or for concrete aggregate where fire resistance is not necessary, and its chemical quality is such that much of it could be burned for agricultural lime or Portland cement. Although it generally has but little silica, alumina, or magnesium, there are certain layers in which these impurities occur making them suitable for natural cement and they have been so utilized along the Potomac. The detailed descriptions of quarries and exposures, together with analyses, will be found in Chapter XVIII under the subject of "Limestone."

BLOOMSBURG RED SHALE.

GENERAL ACCOUNT, BLOOMSBURG RED SHALE.

The **Bloomsburg Red Shale,** so called by Dr. I. C. White from its occurrence in Columbia County, northeastern Pennsylvania, is a group of mixed red and green, sandy or argillaceous shale containing a hard sandstone member of variable thickness and lying between the Rondout and Niagara Limestones. These shales are well exhibited in the Potomac Section, page 136, being 68 feet thick, with two streaks of sandstone. In the Falls Section, page 175, they are recorded as 80 feet thick, with 25 feet of sandstone at the top; and in the Maysville Section, page 176, they are represented only by a 10-foot sandstone member. The thickness of the formation appears in general to vary from 25 to 100 feet, reliable measurements being difficult to obtain on account of the usually crushed condition of the incompetent shale.

The Bloomsburg is apparently a portion of the Onondaga Salt Group of New York State, later known more extensively as the Salina Formation. In the Pawpaw-Hancock Folio along the Potomac River it is recognized by Stose and Swartz as a member of the Wills Creek Shale and is therein assigned to the Salina being described as the "Bloomsburg Red Sandstone."

TOPOGRAPHIC EXPRESSION, BLOOMSBURG RED SHALE.

Although composed largely of shale the Bloomsburg contains a sandstone member of such durability that its pres-

ence is nearly everywhere indicated by a sharp, narrow ridge or reef rising above the general surface which is the more noticeable because there are pronounced dips at nearly all localities where it outcrops, making it protrude through the less resistant limestones and shales.

AREAL EXTENT, BLOOMSBURG RED SHALE.

In Mineral County, as shown by Map II, the Bloomsburg Red Shale does not outcrop east of Knobly Mountain. West of this ridge in the region southwest of Cumberland, it is found in the valley of North Branch of Potomac partly in Maryland and partly in West Virginia depending on the meanders of the river which are frequently crossed. All of its areas are very narrow, as it is usually pitching at a sharp angle. In the first large bend of the river opposite Roberts, it occurs in a strip more than a mile in length but is largely covered by alluvium. In the next westward bend between Cedar Cliff and Riverside, it crosses the river about one-fourth mile west of the old cement mine and passing southwestward across the flood-plain, it may be easily recognized at the foot of Knobly Mountain just east of Seymour and it keeps this approximate position to a point one-half mile southeast of Riverside where it crosses into Maryland through the wide bend opposite the Baltimore and Ohio Railroad tunnel but comes back into West Virginia one-half mile north of Short Gap and forms an ellipse around the descending axis of the Wills Mountain Anticline, the western limb passing back into Maryland one-half mile east of Potomac Station, being well exposed at this latter point.

For the next nine miles the structure of the Wills Mountain and other folds is too low for the Bloomsburg to appear but just southwest of O'Neil Gap the rising axis of the Wills Mountain Arch brings it out again and the two limbs of it extend southwestward. That on the southeastern side of the anticline crosses the Keyser-Headsville road, 0.3 mile west of the gap in Knobly Mountain, and passing up the eastern side of Limestone Run goes through the reservoir. Crossing the Northwestern Pike just west of the Arnold residence, 1.5 miles southeast of New Creek village, it crosses Mill Run 0.8 mile northwest of Antioch and reaches the Grant County Line about one mile northwestward from Whip Gap.

From near O'Neil Gap the outcrop on the western flank of the Wills Mountain Anticline crosses the Keyser road at the bend 0.6 mile southeast of the mouth of New Creek, then passes southwestward through a string of well-defined minor knobs about one-half mile east of New Creek Mountain

until it reaches the sharp bend of this mountain at the gap one mile northeast of Claysville. Here is passes to the western side of the mountain and follows its lower slope to the Grant County Line, 0.9 mile southeast of Laurel Dale. It also outcrops on either flank of the Laurel Dale Anticline for a distance of nearly four miles northeastward from the Grant County Line, the crest of the structure being made by Niagara.

In Grant County, as shown by Map IV, the Bloomsburg is first found along the axis of the Patterson Creek Mountain Anticline where a ravine cuts across it about 1½ miles northeast of Williamsport, there being a belt nearly one mile long surrounding a smaller area of Niagara. On the branch of Patterson Creek through which the Williamsport-Moorefield road passes to the summit of Patterson Creek Mountain, there is another elliptical outcrop surrounding a body of Niagara and Clinton, there being a good exposure 0.6 mile east of Williamsport and another one-fourth mile northwest of the summit of the mountain.

In the Elkhorn Mountain country it outcrops on either limb of the Elkhorn Mountain Anticline, starting at the Hardy County Line 0.6 mile northwest of Elkhorn Knob, crossing the public road 0.7 mile southeast of Cedar Knob and the next road one-half mile southeast of Getz School and turning eastward around the descending axis of the anticline 0.7 mile southeast of Bergdoll School. This latter belt crosses the mountain road 0.6 mile west of Ketterman School and passes into Hardy County about one mile farther on.

West of Knobly Mountain the strip of Bloomsburg above described as entering Grant County from Mineral one mile northwestward from Whip Gap passes southwestward through the low topography between Knobly and New Creek Mountains, often making a sharp minor ridge or reef. It crosses North Fork of Patterson Creek 0.8 mile northwest of Falls, Lunice Creek 0.8 mile northwest of Maysville, South Fork of Lunice Creek 0.6 mile west of Kline Gap School, and North Fork of South Branch of Potonac 1.8 miles southwest of Corners. Beyond North Fork in the Smokehole Settlement it crosses Redman Run about one mile southwest of its mouth and passing on to the head of Long Run it extends down this stream to the Pendleton County Line, being exposed at numerous points along the Long Run-Redman Gap trail.

In the same region it is also brought to the surface by the Cave Mountain Anticline in the ravine east of Shoock Gap where it surrounds a small body of Niagara and Clinton

and southwest of this locality along the same anticline it is the upper (eastern) formation along the plane of the overthrust fault for about 1½ miles northeast of the Pendleton County Line and then winds eastward across the Cave Mountain arch southward along its eastern limb into Pendleton County.

West of New Creek Mountain and the Wills Mountain Anticline, the Bloomsburg enters the county 0.8 mile southeast of Laurel Dale and follows southwestward along the slope of the mountain, there being also strips of it on either side of the Laurel Dale Anticline farther west which join together and go under drainage near the southern end of this minor fold about one-half mile northeast of Oakdale School. The main belt crosses the public road just east of the large sink 1½ miles northward from Greenland, being conspicuous at this point, crosses North Fork of Patterson Creek 0.2 mile southwest of Greenland, Lunice Creek 0.2 mile southeast of Brick Church, South Fork of Lunice Creek 0.4 mile southeast of Streby, and passing to the waters of Jordan Run with the same relationship to New Creek Mountain it crosses North Fork of South Branch one-fourth mile east of Jordan Run. Beyond this point it goes on to Pendleton County, its position being generally toward the lower western slope of North Fork Mountain which is a structural extension of New Creek Mountain.

CONTACTS, BLOOMSBURG RED SHALE.

The contact of the Bloomsburg Red Shale with the Rondout Waterlime above it has been discussed under the latter formation, page 389, the sudden subsidence of the tidal basin floor of the Bloomsburg stage being considered as the main cause of the change from red shale to limestone, without any extensive lapse of time. At its base the Bloomsburg rests upon the marine Niagara Limestone and hence there must have been a reversal of the conditions that prevailed at the upper contact, diastrophic action being responsible for a change from a depth of water sufficient to favor normal marine life to one in which only salt lagoons existed and the oxidation of sediments as well as the destruction of animal life frequently took place. It does not appear probable that an extensive time break occurred at this level, however, since several of the Niagara ostracods are described by Ulrich (see quotation on page 373) as persisting into the Wills Creek (Rondout) Formation without much change. If this be true these organisms must have persisted in an outer sea while the Bloomsburg beds were forming in extensive inner lagoons.

FOSSIL LIFE, BLOOMSBURG RED SHALE.

The Bloomsburg of Mineral and Grant Counties appears to be almost entirely barren of marine life. No fossils of any kind were observed in the shales proper but in the sandstone member a limited fauna was found at one locality. This exposure is located in the public road on the western slope of Knobly Mountain just northwest of the residence of D. A. Arnold, 1.3 miles northwest of Ridgeville, Mineral County. Here the Williamsport Sandstone is 15 feet thick and bedded in red and green shales and dipping southeastward 25°, with the Rondout Waterlime outcropping on the southeast and the typical Niagara on the northwest. Fossils were found only on the upper surface of the rock where a collection was made by the writer. According to Dr. Tilton, whose report appears in Chapter XXI, the only species capable of identification is **Leperditia alta** but there are plant-like forms that are of interest. Another collection made at the same locality by Scheffel and Price was examined by Dr. Prouty and is also reported in Chapter XXI, some additional genera being found but not given specific designation.

The presence of Eurypterids, which characterize the typical Salina beds of New York State, were not noted in either county. These may have escaped attention but since they are not reported in Pennsylvania or Maryland their general absence in West Virginia would not be surprising.

A summarized list of the fossils identified by Drs. Tilton and Prouty from the Bloomsburg of Mineral County is as follows:

Leperditia alta (Conrad)
Lingula sp.
Modiolopsis sp.
Cornulites sp.
Homeospira close to H. evax var. marylandica (Prouty)
Also branching plant-like forms that may be Buthotrephis.

SUBDIVISIONS, BLOOMSBURG RED SHALE.

In Columbia County, Pennsylvania, where the Bloomsburg is named by Dr. White, it is described as being 450 to 500 feet thick and composed principally of red, green, and variegated shale, no sandstone or limestone members being noted and no subdivisions being made. In Mineral and Grant Counties the shales contain no limestone but there is a persistent sandstone that may be seen at nearly all points where the group outcrops, and this may be readily traced. It is herein designated as the **Williamsport Sandstone**, its descrip-

tion being given below. With the exception of this member the Bloomsburg Red Shale does not appear susceptible of further subdivision or description.

Williamsport Sandstone.

The **Williamsport Sandstone,** as herein termed, has its typical exposure on a short branch of Patterson Creek 0.6 mile east of Williamsport, Grant County, at a point where a short private road turns northeastward from the main Williamsport-Moorefield highway. Here it is 25 feet thick, reddish-brown in color, and dips northwestward at an angle of 40°, so that it makes a prominent reef where it protrudes from the ground, the elevation at this point being 1245′ B. Slightly to the westward the Rondout Waterlime appears while toward the east in the direction of the axis of the Patterson Creek Mountain Anticline the Niagara Limestone and Clinton Shales also appear in succession. No detailed section was measured to fix its exact interval to the Rondout and Niagara but such a measurement would have only local significance as there is no other sandstone in the Bloomsburg Shale which at some points is eroded at the top permitting the sandstone to come directly beneath the Rondout and at other localities has disappeared below so that this member is just above the Niagara, while in rare instances the sandstone is the only stratum left between these two calcareous formations.

The Williamsport Sandstone is variable in color, its basic gray being nearly always tinged with combinations of red, green or brown. As a rule it is massive, extremely hard, and very fine-grained, being indurated by incipient metamorphism so that at first glance it gives the impression of a quartzite, although pebbles or coarse sand grains are entirely lacking. Its thickness varies from 5 to 50 feet, the average being about 15 feet. As previously noted on page 395, it carries marine fossils, among which is **Leperditia alta,** at one point in Mineral County, and it is possible that a further search might reveal them at other localities.

In Mineral County the Williamsport Sandstone outcrops on the south side of North Branch of Potomac River, 0.1 mile south of Seymour, at an elevation of 675′ B., being thin and red; also it is visible in the same locality, 0.3 mile south of Seymour, at an elevation of 735′ B., being greenish-red and flaggy. In the Potomac Section, page 136, it is recorded as 8 feet thick, hard and greenish-brown. On the head of Mikes Run of Patterson Creek 0.8 mile southeast of Dolls Gap, it is 50 feet thick, massive, and greenish-brown, with an elevation of 1380′ B. and a southeastward dip of 35°, this be-

ing its greatest thickness noted in either county. Just east of the summit of Knobly Mountain, 1.3 miles northeast of Ridgeville, it is visible on the two highways that converge at the residence of D. A. Arnold, its outcrop being just west of the road fork, and the more northern of these two exposures being fossiliferous and 15 feet thick, as previously described. On the southern road there is 25 feet of it visible and it is somewhat shaly. In the same neighborhood and on the same side of Knobly Mountain it is exposed in a road 1.2 miles northeast of New Creek village, being greenish-red and 15 feet thick, with an elevation of 1020′ B.; and in the road 0.1 mile west of Sunnyside School it is 15 feet thick, reddish-green, and has a dip of 60° southeastward, this being in a zone of local, subordinate flexure. On Limestone Run, 0.8 mile southeast of Keyser, it is exposed in the road just northwest of the cemetery, its thickness being 10 feet, color reddish-green, and dip 64° northwest. On the eastern side of New Creek it is well exposed on the slope of New Creek Mountain 0.4 mile northeast of Laurel Dale at an elevation of 1440′ B., being 15 feet thick, reddish-green, fine-grained, and hard, and dipping southeastward into the mountain and toward the Laurel Dale Syncline at an angle of 50°.

In Grant County the Williamsport Sandstone is visible at its type locality as already described, and also on the eastern side of the Patterson Creek Mountain Anticline on the same road leading from Williamsport to Moorefield, 1 mile southeast of Williamsport, at an elevation of 1640′ B. and with a southeastward dip of 25° and a thickness of 15 feet. On North Fork of Patterson Creek, 0.8 mile northwest of Falls, it is 25 feet thick, as recorded in the Falls Section, and on the road 1.6 miles north of Greenland it crosses the highway just east of a big sink, being reddish-green and thin but making a prominent reef on account of an anticlinal flexure. On the road which leads southwestward from Greenland up a branch of North Fork of Patterson Creek, the entire Bloomsburg is exposed in a ravine just west of the residence of Calvin Lyons and 1.5 miles from Greenland, the exposure in descending order with a dip of 65° to 75° being as follows:

	Feet.
1. Limestone, flaggy, dark, **Rondout**	
Bloomsburg Red Shale (35′)	
2. Shale, green, fissile, sandy	25
3. Sandstone, hard, compact, greenish-brown, **Williamsport**	10
4. Limestone, flaggy, fossiliferous, **Niagara**	....

In the Elkhorn Mountain country southeast of Petersburg the sandstone is well exposed on Elkhorn Run 0.4 mile southeast of Cedar Knob, being 20 feet thick, hard, and fine-grained, with an elevation of 1790′ B.; and on the head of Long Run of South Mill Creek 0.6 mile south of Getz School it is 25 feet thick and reddish-green, with a southeastward dip of 40° and an elevation of 2095′ B.

In the Smokehole Settlement west of South Branch of Potomac it is conspicuous along a trail, or private road, which goes from the head of Redman Run southward across the divide to Long Run and thence on to the Pendleton County Line, there being numerous exposures.

ECONOMIC ASPECTS, BLOOMSBURG RED SHALE.

The Bloomsburg Red Shale offers nothing of special value in the way of economic products. At a few convenient points the shales might be made into brick and the sandstone might be utilized to a limited extent in masonry structures or as concrete or road material. The soil is usually poor, being littered with debris from the sandstone.

NIAGARA LIMESTONE.

GENERAL ACCOUNT, NIAGARA LIMESTONE.

The **Niagara Limestone,** coming just below the Bloomsburg Red Shale and just above the Clinton Series, is a mass of wavy-bedded, or flaggy, calcareous material, containing frequent thin strata of limy shale. It is uniformly bluish-gray or dove-colored, and owing to the included shale does not make cliffs or reefs like the Rondout, Bossardville, and Helderburg, but usually weathers to a thin soil from which the thin crystalline flags often protrude. It is abundantly fossiliferous throughout, **Rhynchonella neglecta** (Hall) and other characteristic Niagara forms being recognized by Dr. Tilton. Its thickness varies from 150 to 400 feet. In the Potomac Section, page 136, it is recorded as only 100 feet, but a careful measurement along the road on the western slope of Knobly Mountain about 1½ miles northwest of Ridgeville, Mineral County, shows 385 feet. In Grant County its thickness in the Falls Section, page 175, is 291 feet, and in that for Maysville, page 176, it is 161 feet. On a branch of North Fork of Patterson Creek 1½ miles southward from Greenland there is visible a thickness of 200 feet. Another exposure on the head of Long Run of South Mill Creek, 0.6 mile south of Getz School totalled 240 feet. In the Smokehole Settlement in the edge of Pendleton County, there is a fairly good

exposure in a ravine southwest of the residence of Joab Kimble and 1.3 miles southwest of Ketterman, there being about 300 feet of it.

In the Pawpaw-Hancock Folio of Stose and Swartz, covering territory farther east along the Potomac, the beds herein correlated as Niagara were termed as the "McKenzie Formation" following the verdict of Ulrich that the fossils of the main upper portion were Salina types and that species of the Rochester Shale subdivision of the Niagara were found only in a few feet of the basal part. In the Jefferson, Berkeley, and Morgan Report of the West Virginia Survey, however, it has been pointed out by Grimsley that Prouty has put all the beds of the McKenzie in the true Niagara and they were consequently so classified in the Report mentioned.

In New York State the Niagara beds have been described by Hall[25] as composed of the Niagara or Lockport Limestone at the top, followed by the Niagara or Rochester Shale at the base, the former having a thickness of 30 to 164 feet and the latter 80 to 100 feet. In the Pawpaw-Hancock Folio the McKenzie is reported as quite shaly with thin streaks of limestone followed at the base by a heavy sandstone separated into two beds at some localities by a stratum of black shale. In Mineral and Grant Counties the group appears to contain a much larger percentage of limestone than in the region of the Pawpaw-Hancock Folio and sandstone is noted only in some of the southern exposures in Grant County. Its lithology is in close harmony with Hall's description of the Lockport or Niagara, the dull ashen weathering of the strata being quite noticeable, as well as many other characteristics. A collection made by the writer across the face of the thickest outcrop found in the two counties reveals fossils that Dr. Tilton does not hesitate to class as Niagara so that its reference to this group does not appear to be in doubt. It may well be possible that in the Pawpaw-Hancock area conditions more nearly approaching those of Salina time prevailed, as is indicated by red and green shales and by the fragments of a eurypterid found there in the Keefer Sandstone,* while at the same time deeper water with unrestricted

[25]James Hall, Natural History of New York, Part IV, Fourth Geological District, pp. 80-117; 1843.

* In its recently published volume on the Silurian the Maryland Survey puts the Keefer Sandstone in the Rochester formation of the Clinton Group, the supposed presence of the Keefer in the base of the McKenzie being declared erroneous. The beds assigned to the Rochester by the Maryland Survey and placed under the Clinton Group are also placed in the Clinton in the Mineral and Grant Report, but the propriety of calling them "Rochester" is not herein affirmed.

access to the open sea occurred in the territory now under discussion so that a duplication of typical Niagara types was possible.

TOPOGRAPHIC EXPRESSION, NIAGARA LIMESTONE.

Being flaggy and somewhat shaly the Niagara weathers rapidly and its occurrence is marked by low ground or benches unless thoroughly protected along mountain slopes by more resistant strata. It has no tendency toward making cliffs and is seldom well displayed except in localities where it has been uncovered in gullies or by artificial cuts. In most regions of its outcrop, however, there are abundant flags or fragments in evidence so that its identification is not difficult.

AREAL EXTENT, NIAGARA LIMESTONE.

In Mineral County, as shown by Map II, the Niagara Limestone does not outcrop east of Knobly Mountain but along North Branch of Potomac there is a small area on the south side of the river in the bend opposite Roberts, and another strip about two miles in length extending from the bend west of Cedar Cliff southwestward to a point one-third mile southeast of Riverside. Here it again crosses through Maryland territory for about one mile and then makes a loop around the declining axis of the Wills Mountain Anticline in the broad bottom southeast of Potomac Station. In all three of these localities it is largely covered by river-terrace material so that little opportunity is afforded for its study.

Farther southwest along the Wills Mountain Anticline it is covered by younger rocks for nearly nine miles but in the region one-half mile southwest of O'Neil Gap and two miles northeast of Keyser the rising axis brings it to the surface. On the eastern side of the arch a narrow belt extends from the locality named southwestward into the valley of Limestone Run and thence up the eastern side of this stream embracing the dam of the reservoir and then on with the lower slope of Knobly Mountain and across Mill Creek at a point 0.8 mile northwest of Antioch beyond which it follows the lower eastern slope of New Creek Mountain to the Grant County Line about one mile northwest of Whip Gap.

The western limb of the outcrop which starts near O'Neil Gap passes across Limestone Run in the vicinity or just west of the Keyser cemetery and extends up a branch of this stream and on through low benches at the western foot of Abrams

Photo by E. E. HARRIS.

PLATE XXII.—View from road south of Potomac Station looking east at Knobly Mountain beyond bend of North Branch of Potomac River. In the mountain front the cliffs are Helderberg, Bossardville, and Rondout Limestones followed in the valley by Bloomsburg, Niagara, and Clinton which caps the Wills Mountain Anticline in the foreground.

Ridge, passing just west of Sunnyside School and through the low gap of New Creek Mountain 0.9 mile northeast of Claysville and thence southwestward with the lower western slope of this mountain to the Grant County Line 0.9 mile southeast of Laurel Dale.

Another small area of Niagara is found along the axis of the Laurel Dale Anticline, starting 0.8 mile south of Claysville and continuing to the Grant County Line south of Laurel Dale.

In southeastern Grant County, as shown by Map IV, the Niagara is above drainage in the Elkhorn Mountain country, its outcrop starting at the Hardy County Line 0.6 mile northeast of Elkhorn Rock and passing southward through a low divide and small sink west of the rock named and through a much larger sink that occurs along the axis of the Elkhorn Mountain Anticline and the Hardy County Line 1½ miles southeast of Masonville and thence on southwestward with the axis of the anticline to the head of a branch of South Mill Creek about three-fourths mile southeast of Bergdoll School, there being a few small areas of Clinton at points where deep ravines cross the arch.

Farther northwest the outcrop mentioned as passing into Grant from Mineral at the foot of New Creek Mountain northwest of Whip Gap extends southwestward generally through the low topography between New and Knobly Mountains, crossing North Fork of Patterson Creek 1 mile northwest of Falls, Lunice Creek at the mouth of Shell Run 1 mile northwest of Maysville, South Fork of Lunice Creek 0.8 mile west of Kline Gap School, and reaching North Fork of South Branch of Potomac River 1.8 miles southwest of Corners. Beyond North Fork it passes to the head of Redman Run of South Branch and thence with the private road from that stream to Long Run and on with this road to the Pendleton County Line 1.2 miles northwest of Ketterman.

East of South Branch in the Smokehole Settlement, there is a small area of Niagara on the Cave Mountain Anticline in the ravine along which Shoock School is located, the topography being weathered down into the Clinton in a small territory immediately surrounding the schoolhouse. Farther south along the same anticline there is another belt of it, starting at the Pendleton County Line on the eastern slope of the arch but on the western side of the mountain of the same name 0.8 mile northeast of Ketterman, and passing northward for about one mile with the slope of this mountain and thence westward with a spur which crosses the anticline, and crossing the river a short distance north of the

store of John Self and thence southwestward along the eastern side of the fault-plane to the Pendleton Line one-third mile northeast of Ketterman.

On the western side of New Creek Mountain and the Wills Mountain Anticline, the outcrop named as coming into Grant County 0.9 mile southeast of Laurel Dale extends on to the road summit 1.4 miles north of Greenland and thence southward with the road to Greenland, making several small sinks in this distance, and then across North Fork of Patterson Creek and on through a low gap 0.6 mile east of Forest Hill School and to Lunice Creek 0.3 mile east of Brick Church. Beyond Lunice Creek it crosses South Fork 0.5 mile southeast of Streby and reaches North Fork of South Branch of Potomac one-fourth mile east of the mouth of Jordan Run and thence follows the western slope of North Fork Mountain to the Pendleton County Line.

Along the Laurel Dale Anticline the strip mentioned as following the axis of that fold into Grant County south of Laurel Dale follows the same on to the head of New Creek, and goes under drainage 0.8 mile northeast of Oakdale School.

CONTACTS, NIAGARA LIMESTONE.

The upper contact of the Niagara with the Bloomsburg above it has already been discussed, page 394, the change in lithology at the contact-plane being ascribed to disastrophic action rather than to a long time break. At its base it rests almost directly upon the Fossil Ore Horizon of the Clinton Shale, there being usually only a few feet of typical Clinton between the ore and the more calcareous Niagara. That there is a slight unconformity at the contact-plane may be safely assumed because of the fact that much additional shale of Clinton age and lithology occurs in other Appalachian States in the interval between the ore and the Niagara, as well as by the marked change in fossil life and sedimentary characteristics. At this level the flaggy and somewhat shaly Niagara Limestone generally overlies the more massive stratification of red hematite ore but at some localities there are a few feet of reddish-brown, sandy shale above the ore. In such case their lithology is sufficiently distinctive to indicate their affinity with the Clinton, since the Niagara is uniformly gray and calcareous.

FOSSIL LIFE, NIAGARA LIMESTONE.

The Niagara of the two counties is abundantly fossiliferous throughout its mass, its fauna being largely made up of

ostracods and small brachiopods with a few cephalopods. Two collections made by the writer, with identifications by Dr. Tilton, and three others made by Scheffel and Price, with identifications by Dr. Prouty, are described in Chapter XXI.

A summarized list of all fossils identified from the Niagara Limestone by Drs. Tilton and Prouty in the two counties is as follows:

Rhynchonella neglecta (Hall)
Strophostylus cyclostomus (Hall) ?
Buthotrephis ?
Leperditia faba (Hall)
Leperditia alta (Conrad)
Kloedenella (number of species)
Beyrichia moodeyi (Ulrich and Bassler)
Kloedenia sp.
Eukloedenella sp.
Orthoceras simulator (Hall)
Orthoceras undulatum (Hall) ?
Orthoceras sp.
Whitfieldella marylandica (Prouty)
Whitfieldella cylindrica (Hall)
Whitfieldella sp.
Homeospira evax var. marylandica (Prouty)
Worm boring in sandstone looks like Arthrophycus
Modiolopsis sp.
Hormatoma sp.
Leiopteria sp. (Prouty)
Actinopteria sp.
Ramose bryozoa
Nucula sp.
Reticularia bicostata var. marylandica (Prouty).

SUBDIVISIONS, NIAGARA LIMESTONE.

As previously stated the Niagara beds of New York State were described by James Hall as composed of the Niagara or Lockport Limestone at the top, followed by the Niagara or Rochester Shale at the base. In the Pawpaw-Hancock Folio the beds herein described as Niagara are not recognized as such, although the presence of Rochester fauna in the basal portion is admitted and it is stated that there is a less marked resemblance in the upper beds. The "McKenzie" of that folio, which without much doubt appears to correlate with the Niagara of this Report, is described by Stose and Swartz as composed of "Thin beds of gray, crystalline limestone in gray shale, with hard, white sandstone beds at the base." This lower sandy portion is given the name of **Keefer Sandstone**,* the statement being made that this

* The verdict in the Maryland Silurian volume that the Keefer Sandstone belongs in the Clinton instead of the McKenzie has been mentioned in a previous note. This correction does not affect the Niagara of the Mineral and Grant Report, since no such a member was recognized in the beds classified as Niagara.

member thins out and disappears westward in the Cumberland region.

In Mineral County no sandstone was observed in the Niagara, the entire formation being composed of alternating thin beds of limestone and calcareous shale. In southeastern Grant County, however, some sandy beds appear, as shown by the following section, measured in descending order along a mountain road just east of the Elkhorn Mountain Anticline and 0.6 mile west of Ketterman School:

	Thickness. Feet.	Total. Feet.
1. Limestone, flaggy, **Rondout**		
Bloomsburg Red Shale (25′)		
2. Sandstone, reddish-green, **Williamsport**	25	25
Niagara Limestone (240′)		
3. Shale and limestone, fossiliferous	20	45
4. Sandstone, reddish-green	60	105
5. Shale, sandy	60	165
6. Limestone, flaggy and shaly, fossiliferous	100	265
Clinton Series (75′+)		
7. Iron ore, **Fossil Ore Horizon**, thickness concealed	.....	.....
8. Shale, sandy, to reversal of dip at anticline	75	340

At the above locality the stratigraphic association is such that neither the upper nor lower contact of the Niagara is in doubt, so that the thick sandstone coming well up toward the top of the formation is clearly a local and lenticular occurrence. No other exposure of this sandstone in either of the two counties was observed.

ECONOMIC ASPECTS, NIAGARA LIMESTONE.

The chief economic function of the Niagara Limestone in the two counties in the past has been as a producer of agricultural soil. Its outcrop is uniformly good grazing land but owing to the multitude of thin protruding flags its cultivation for crops is often difficult except where extreme disintegration has occurred. In almost any case, however, the calcareous matter derived from it has greatly enriched the thin Clinton soil that lies below it. An analysis of the Niagara Limestone is published in Chapter XVIII and suggestions are therein made for its commercial utilization. Owing to its shaly character and tendency toward rapid disintegration, it would hardly prove suitable for construction material but its low content of both silica and magnesia should make it of value for agricultural lime and possibly for Portland cement.

CLINTON SERIES.

GENERAL ACCOUNT, CLINTON SERIES.

The **Clinton Series,** next underlying the Niagara Limestone and including the ferruginous deposits down to the top of the White Medina Sandstone, consists primarily of olive-green, yellow, or reddish shales. In their upper portion there is contained a quite persistent bed of red hematite, long known as the "Fossil Ore Horizon," and at the base there occurs a massive, red, ferruginous sandstone. No limestone was observed in the series at any point in either county but the Fossil Ore Horizon is recognized as a limestone in which percolating ferruginous waters have almost entirely replaced the original lime content of the member near the surface, while a progressively increasing calcareous percentage is found with depth.

The olive-green shales that form the bulk of the Clinton are platy, or fissile, argillaceous in part but more inclined to be sandy, often containing small included lenses of flaggy sandstone, and having a variable content of iron, the chemical and qualitative variations of which are responsible for local differences in color. They contain only a scanty marine fauna. Both the Fossil Ore Horizon and the basal Iron Sandstone are fossiliferous but the former contains shells in great abundance while the reverse statement is true of the latter.

The thickness of the Clinton in the two counties appears to vary in general from 300 to 600 feet. In the Potomac Section, page 136, it is recorded as 655+ feet, the base not being visible. In the Falls Section, page 175, its full thickness is 629 feet; and in the Maysville Section, page 176, it is only 312 feet. As compared with other regions these thicknesses indicate an intermediate phase of the series. In western New York State it is reported as only 75 to 125 feet thick, but in central Pennsylvania totals of 1000 to 1500 feet are recorded. In this latter region rocks of probable Niagara age are admittedly included in the Clinton, but a deduction of any possible amount of Niagara would still leave the Clinton much thicker than in Mineral and Grant Counties. From a study of the New York State Reports it is evident that the Clinton of the two counties does not include some of the upper limestones and shales of that region but on the other hand contains some older strata. From the Pennsylvania reports it is apparent that most of the upper limestones and shales above the Fossil Ore Horizon and most of the shales below the Iron Sandstone have thinned away in West Virginia.

In some neighboring regions of the Appalachian belt the shaly upper portion of the Clinton has been termed the "Rockwood Formation" and the Iron Sandstone has been called the "Cacapon Sandstone" in folios of the United States Geological Survey, but in the more recent Pawpaw-Hancock Folio the Clinton age of these beds has been recognized. The correlation of these rocks with the Clinton as originally defined in New York State and as traced to its more amplified occurrence in Pennsylvania appears to be justified both from the standpoint of paleontology and well-sustained lithology so that the earlier inclusive group name is herein adopted.

TOPOGRAPHIC EXPRESSION, CLINTON SERIES.

In Mineral and Grant Counties the Clinton outcrop produces no individual topographic forms. Its most resistant member is the basal Iron Sandstone which is durable but which is always subordinate to the much greater mass of White Medina lying just below it. These formations together make the protective backbone of the principal extent of New Creek Mountain but the Iron Sandstone is usually found only along the lower slope, being generally eroded from the summit. The same condition occurs along North Fork Mountain and to a less degree along the northwestern slope of Elkhorn Mountain. Above the Iron Sandstone the shales of the Clinton weather in much the same way as the Niagara Limestone and they thus form the lower slopes of the mountains containing the exposed Iron Sandstone and White Medina or partially merge into the low topography made by the Niagara. The Fossil Ore Horizon at the top of the series is quite hard but makes no noticeable reef, since it is affected by much longitudinal fracture causing the exposed edges of the strata to break off in long, rectangular blocks. These blocks, as well as the more irregular boulders from the Iron Sandstone, litter the mountainsides where they occur and by their deep-red color and weight afford an easy clue to the location of the ore deposits.

AREAL EXTENT, CLINTON SERIES.

In Mineral County, as shown by Map II, the Clinton Series does not outcrop east of Knobly Mountain. West of this range in the northeastern part of the county, there is a belt less than one mile in length lying in a westward bend of North Branch of Potomac River, and entering the State just southwest of Brady but passing out of it again just southeast of Riverside; and there is another short strip, hardly

more than one-half mile long, lying along the descending axis of the Wills Mountain Anticline in the wide river bottom three-fourths mile southeast of Potomac Station. Both of these short outcrops are almost entirely covered by Pleistocene or Recent material.

Farther southwest the Clinton comes to the surface again on the rising axis of the Wills Mountain Anticline two miles northeast of Keyser and at the western base of Knobly Mountain. For slightly more than two miles southwestward along the axis it covers this arch, being plainly visible in the vicinity of the cemetery near which it crosses Limestone Run, but in the northern end of Abrams Ridge it is divided into two limbs by the White Medina which is exposed for 2½ miles in the high dome of the ridge. One-half mile north of Wilson School the two limbs of Clinton reunite across the axis and continue southwestward through some low hills between Knobly Mountain and the low northern extension of New Creek Mountain, this outcrop being one-half mile or more in width and extending to the northern promontory of the main ridge of New Creek Mountain 1.8 miles south of New Creek village. Here it is again divided by the White Medina, the eastern limb being located along the base of the mountain all the way to the Grant County Line, a distance of 5½ miles, but the western belt being higher up against the ridge on account of the asymmetrical nature of the arch and because of the presence of subsidiary folds which widen the slope of the mountain. This latter outcrop crosses the Grant County Line 0.9 mile southward from Laurel Dale.

In southeastern Grant County, as shown by Map IV there are several small isolated outcrops of Clinton along the Elkhorn Mountain Anticline, the largest of these being 1½ miles long, starting at the Hardy County Line one-half mile northwest of Elkhorn Rock and extending southward to the locality where the anticline and the Grant-Hardy County Line cross Elkhorn Run, and then passing eastward across the declining axis into Hardy County. There is another partial outcrop where the anticline crosses the road from Getz School to Ketterman School, another at a small ravine three-fourths mile farther southwest, another on Rough Run, and still another on the head of Waterfall Run, all being along the axis of the arch. Beyond Waterfall Run to the Pendleton County Line the formation is entirely under drainage.

The belt of Clinton described as entering Grant County from Mineral at the eastern base of New Creek Mountain preserves the same relationship all the way southwestward

to North Fork of South Branch of Potomac River, a distance of 22 miles. This outcrop crosses North Fork of Patterson Creek 1 mile northwest of Falls, Lunice Creek 1 mile northwest of Maysville, South Fork of Lunice Creek 0.9 mile west of Kline Gap School and reaches North Fork of South Branch 2 miles southwest of Corners. At two points along this 22-mile stretch, however, the Clinton passes westward through comparatively low topographic and structural saddles and joins with the area mapped along the western slope of New Creek Mountain, one of these localities being at the highway crossing 1.8 miles northwest of Oak Hill School and the other in the gap just southwest of Mountain Top School. Beyond North Fork of South Branch the outcrop extends southwestward approximately with the base or lower eastern slope of North Fork Mountain to the Pendleton County Line 1.3 miles northwest of Ketterman, the low saddle between the heads of Redman and Long Runs being formed by it.

Farther east in the Smokehole Settlement the top of the Clinton is visible at Shoock School where the Cave Mountain Anticline crosses an eastern tributary of South Branch, and farther south along the same arch its entire thickness is above drainage in the bluffs that overlook the tortuous river channel near the Pendleton County Line.

West of New Creek Mountain the outcrop described as entering Grant from Mineral 0.9 mile southward from Laurel Dale follows southwestward along the middle slope of the mountain to North Fork of Patterson Creek directly east of Greenland, thence with the same relationship on to Lunice Creek 0.3 mile east of Brick Church, thence on to South Fork of Lunice Creek three-fourths mile southeast of Streby, and thence on to North Fork of South Branch of Potomac one-fourth mile east of the mouth of Jordan Run. Throughout this distance the occupation of the axis of the arch by two small bands of Clinton across structural saddles has already been mentioned.

South of North Fork the same outcrop continues along the middle western slope of North Fork Mountain to the Pendleton County Line 1½ miles southeast of the mouth of Mill Run.

Among the outcrops above described the best opportunities for the study of the Clinton Series are afforded at the eastern and western entrances to Greenland, Cosner, and Kline Gaps in Grant County where small creeks cut across its upturned edge. In North Fork Gap the same situation occurs but the exposures are not good.

CONTACTS, CLINTON SERIES.

The upper contact of the Clinton Series with the Niagara Limestone above it has already been discussed, page 402, a time break and a noticeable change in lithology being indicated. At its base it rests upon the great White Medina Sandstone, which is a very pure quartzite contrasting sharply with the red Iron Sandstone of Clinton age which usually rests almost directly upon it. Being almost devoid of organic remains the Medina represents a stage of deposition in which a great influx of fresh water must have occurred while the Clinton was formed under more placidly marine conditions. No criteria are afforded by which the lapse of time between the two formations may be gauged but the abrupt change from a shore-line quartzite to marine sediments indicates diastrophic action of some magnitude.

FOSSIL LIFE, CLINTON SERIES.

The most abundant occurrence of marine fossils in the Clinton Series is in the Fossil Ore Horizon near the top of the formation. Here the calcareous content of a probably impure and siliceous marine limestone has been largely replaced by iron oxide through the agency of percolating colloidal solutions, acting so gently that the structure of the shells has been but little disturbed. These fossils are mostly ostracods but there are other types in less abundance. Fossils are also present in the shales lying between the Fossil Ore Horizon and the Iron Sandstone but are much less conspicuous. In the Iron Sandstone, which is of a porous nature giving evidence of lost calcareous matter, fossils may usually be found.

In the two counties one collection from the Fossil Ore Horizon was made by the writer, the identifications of which by Dr. Tilton will be found in Chapter XXI, and several others, including the various faunal stages, were made by Scheffel and Price, these latter as identified by Dr. Prouty being also recorded in Chapter XXI.

The following is a summarized list of all fossils identified by Drs. Tilton and Prouty in the Clinton Series of the two counties:

Bollia lata (Vanuxem)
Camarotoechia neglecta (Hall)
Leptaena rhomboidalis (Wilckens)
Dalmanella (Orthis) elegantula (Dalman)
Dalmanella elegantula (Dalman)
Chilobolbina cf. punctata (Ulrich and Bassler)
Clay galls
Dalmanella sp.
Orthoceras bassleri (Prouty)
Orthoceras impressus
Calymene cresapensis (Prouty)

Stropheodonta sp.
Stropheodonta convexa (Prouty)
Cf. Stropheodonta corrugata (Conrad)
Stropheodonta corrugata (Conrad)
Stropheodonta corrugata var. pleuristriata (Foerste)
Whitfieldella marylandica (Prouty)
Whitfieldella intermedia (Hall)
Whitfieldella cylindrica (Hall)
Cf. Whitfieldella sp.
Pelecypod
Gastropods (2)
Favosites sp.
Tentaculites ?
Tentaculites cf. niagarensis (Hall)
Buthotrephis gracilis var. intermedia (Hall)
Crinoid sp.
Zygobolba caranifera (Ulrich and Bassler)
Liocalymene clintoni (Vanuxem)
Atrypa reticularis (Linnaeus)
Dalmanites limulurus (Green)
Homalonotus delphinocephalus (Green)
Drepanella clarki (Ulrich and Bassler)
Drepanellina clarki (Ulrich and Bassler)
Pholidops squamiformis (Hall)
Cornulites concavus (Prouty)
Modiolopsis sp.
Kloedenia cacaponensis (Ulrich and Bassler)
Eukloedenella cf. primitoidea (Ulrich and Bassler)
Rhipidomella hybrida (Sowerby)
Schuchertella subplana (Conrad)
Meristina cf. maria (Hall)
Diaphorostoma niagarense (Hall)
Spirifer crispus (Hisinger)

SUBDIVISIONS, CLINTON SERIES.

Although the study of the Clinton Series was first made in New York State by Eaton, Hall, and others, its section there is so different that it can not be applied with certainty to Mineral and Grant Counties, most of its limestones having disappeared in passing southwestward. In Pennsylvania, however, the subdivisions of H. D. Rogers, as made in 1858 and later revised by Dr. I. C. White,[26] are as follows, in descending order:

Upper Shales
Ore Sandstone and Fossil Ore
Middle Shales
Iron Sandstone and Block Ore
Lower Shales.*

In Mineral and Grant Counties the Upper Shales have thinned to small porportions and the Ore Sandstone is insignificant if not entirely absent. The Fossil Ore, Middle Shales, and Iron Sandstone are well represented and easily

[26]See Reports G7, pp. 111-112, 1883, and T3, p. 132, 1885, Second Geological Survey of Pennsylvania.

* In the recently published Silurian volume of the Maryland Geological Survey, an entirely different classification of the Clinton is made. It is too late to discuss these proposed changes in detail but there appears to be no good reason why "Roberts Iron Ore" should be substituted for the **Fossil Ore Horizon**, or "Cresaptown Iron Sandstone" for the **Iron Sandstone** of eastern Pennsylvania.

recognized. The Lower Shales are mostly absent, a thin stratum at this stage being visible at some points.

The following section, measured in descending order westward across rocks dipping steeply eastward at the eastern entrance to Kline Gap, Grant County, shows a quite typical occurrence of the series:

			Thickness. Feet.	Total. Feet.
1.	Limestone, shaly, fossiliferous, Niagara		.....	.....
2.	Shale, sandy, **Upper Shales**		10	10
3.	Iron ore, red, fossiliferous ..... 2′ 0″	**Fossil Ore Horizon**		
4.	Shale, sandy 4 0			
5.	Iron ore, red, fossiliferous 2 0		8	18
6.	Shale, sandy, with thin streaks of iron carbonate ..... 100′	**Middle Shales**		
7.	Shale, greenish-brown, sandy 50		250	268
8.	Concealed 100			
9.	Sandstone, red, porous, and fossiliferous ..... 40′	**Iron Sandstone**		
10.	Sandstone, shaly, ferruginous at top 15		55	323
11.	Concealed, **Lower Shales**		20	343
12.	Sandstone, massive, quartzite, **White Medina**		.....	.....

In the Smokehole Settlement of Grant County, the following section of the Clinton in descending order is visible where the road crosses the neck of a wide bend of South Branch of Potomac 0.4 mile northeast of Ketterman and just east of the overthrust fault-line.

		Thickness. Feet.	Total. Feet.
1.	Shale, sandy, with streaks of iron, **Fossil Ore Horizon**	5	5
2.	Sandstone, gray, quartzitic, very hard, **Keefer?**	5	10
3.	Shale, sandy, greenish-brown	200	210
4.	Sandstone, red, ferruginous, **Iron Sandstone**	50	260
5.	Sandstone, white, **White Medina**	.....	.....

Fossil Ore Horizon.

The **Fossil Ore Horizon,** coming usually near the top of the series, since the Upper Shales have for the most part disappeared, consists of alternating beds of red hematite ore and sandstone or shale, ranging from 2 to 10 feet in thickness. As previously stated the ore is quite fossiliferous, being considered by Dr. White as replaced limestone,[27] since deep

[27] I. C. White, Report G7, Second Geological Survey of Pennsylvania, p. 112; 1883.

mining operations in Pennsylvania have proved it to become leaner in iron and much more calcareous after passing beyond the zone of percolating surface waters. The nature of this ore bed is well illustrated in the Falls Section, page 175, and in Chapter XIX will be found additional sections, together with chemical analyses and estimates of iron content, under the subject of "Iron Ore." The Ore Sandstone, which is described as coming just over the Fossil Ore Horizon in Pennsylvania, was not observed in the two counties.

Middle Shales.

The **Middle Shales,** coming between the Fossil Ore Horizon and the Iron Sandstone and comprising the main bulk of the Clinton, consists of fissile, sandy strata, with occasional lenses of iron carbonate, their color being greenish-brown reddish-brown, or yellow. They contain some marine fossils but not in such abundance as may be found in the Fossil Ore Horizon.

Iron Sandstone.

The **Iron Sandstone,** coming below the Middle Shales and often resting directly upon the White Medina Sandstone but sometimes separated from it by a shale interval, is a constant and easily recognized horizon. It is dark red in color, very hard and durable, a conspicuous feature being small grains of white silica which stand out in relief against the ferruginous matrix. Its thickness varies from 5 to 50 feet with a probable average of about 25 feet, and the region of its outcrop may easily be noted from the great quantities of its boulders which litter the surface and appear to be highly resistant to weathering. It usually contains 10 to 20 per cent. of iron oxide, although these figures are sometimes exceeded and it has been mined for iron ore at a few points, but, being of a siliceous instead of a calcareous base, it does not flux readily so that such attempts have usually produced poor results.

In Chapter V its presence is noted in the sections for Potomac, Falls, and Maysville. In Mineral County it was once mined on the Keyser-Headsville road, 1 mile southeast of Keyser as will be later described in Chapter XIX. Farther south up Limestone Run it is visible at numerous points along the eastern base of Abrams Ridge. Near the western foot of Knobly Mountain about one mile east of New Creek village, it is prominent along the public road, its outcrop making the top of the Wills Mountain Anticline 0.8 mile

northeast of Sunnyside School and also 0.4 mile southeast of the same point. In Grant County it is prominent on the eastern and western sides of New Creek and North Fork Mountains. On the western slope of the former it is 15 to 20 feet thick at an escarpment between Kittlelick Ridge and Black Rocks, this exposure being at an elevation of 2260′ B. and well up against the wooded mountain. Just southeast of Greenland it is visible in North Fork of Patterson Creek, having a thickness of 20 feet. At the eastern end of Cosner Gap there is 15 feet of it visible and at the western end of this gap, as indicated in the Maysville Section, there is 65 feet of it. At the eastern end of Kline Gap it has already been noted as 55 feet thick. In the Smokehole Settlement it is prominent along the bluffs of South Branch of Potomac in the region just north of the Pendleton County Line, being 60 to 70 feet thick at one point in a ravine on the eastern side of the river just east of John Self's store and one-half mile northeast of Ketterman School. Here its base has an elevation of 1285′ B., the ledge being uplifted into an arch. Along the Elkhorn Mountain uplift in southeastern Grant its boulders are visible near the Hardy County Line but no good exposures were noted.

Lower Shales.

The **Lower Shales** of the Clinton, lying between the Iron Sandstone and the top of the White Medina, are usually 20 feet or less in thickness, being entirely absent at some localities. When present they are similar in characteristics to the Middle Shales.

ECONOMIC ASPECTS, CLINTON SERIES.

The principal economic interest in the Clinton Series lies in the Fossil Ore Horizon which usually contains a fair grade of red hematite iron ore. This bed has been mined at different points but all the old operations are now abandoned. The iron Sandstone also has been mined but it is much leaner and more siliceous. An account of these ore beds will be found in Chapter XIX. The Iron Sandstone would make almost indestructible building material if some successful method of quarrying it could be found, and its appearance would be altogether pleasing. The Clinton soil is usually very poor and difficult to cultivate because of many boulders, many of which are derived from the White Medina, but attempts at some localities have been made to utilize it as orchard land.

WHITE MEDINA SANDSTONE.

GENERAL ACCOUNT, WHITE MEDINA SANDSTONE.

The **White Medina Sandstone,** coming just below the Clinton Series and at the top of three Medina formations, is a huge mass of white quartzite, varying in thickness from 200 to more than 300 feet, and containing few, if any, perceptible inclusions of shale. As a rule it is extremely hard and at some localities metamorphism has so far advanced that it gives much the impression of a monolithic silicate while at others the sand grains are distinct, with larger pebbles of pure quartz standing out in relief from the matrix. In Grant County it is recorded in the Falls Section, page 175, as 317 feet thick, in the Maysville Section, page 176, as 212 feet, and in the Hopeville Section, page 177, as 300 feet. In Mineral County the only full outcrop of this rock is at Dolls Gap through New Creek Mountain, but at this locality most of the cliff is obscured by debris so that a measurement could not be made. In Allegany County, Maryland, however, at the gap made by Wills Creek through Wills Creek Mountain just west of Cumberland its thickness is reported by O'Harra[28] as 287 feet, the measurement having been made by a line dropped across the sheer face of the cliff.

In certain folios of the United States Geological Survey as well as in various reports of other organizations the White Medina in regions bordering on the Potomac territory has been described as the **"Tuscarora Sandstone,"** and in parts of southern West Virginia and the adjoining region of Virginia it has been called the **"Clinch Sandstone."** It is acknowledged by nearly all authors, however, that these names are synonymous with the White Medina of the early New York State classification, and since the latter far antedates the others it is herein adopted.

TOPOGRAPHIC EXPRESSION, WHITE MEDINA SANDSTONE.

The outcrop of the White Medina Sandstone is nearly everywhere marked by extremely rugged topography. The best instance of its influence in this respect is in the ridges of New Creek and North Fork Mountains where it is uplifted into a huge anticline. In the former mountain it makes the backbone almost throughout its length except at a few gaps which have been cut through, but in North Fork Mountain the

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[28]C. C. O'Harra, Geology of Allegany County, Maryland Geological Survey, p. 89; 1900.

occurrence is more complicated as will be later described. It also forms the crest of Elkhorn Mountain in southeastern Grant County.

AREAL EXTENT, WHITE MEDINA SANDSTONE.

In Mineral County, as shown by Map II, the only outcrop of the White Medina is along the Wills Mountain Anticline. Just west of the northeastern extension of this county it forms the backbone of Wills Creek Mountain through which a great gap has been cut by Wills Creek just west of Cumberland exposing a complete cross-section of the cliff. Southwest of the Wills Creek Gap, however, the axis of the arch declines so that only the top of this rock is visible in the bend of North Branch of Potomac River between Cresaptown and Riverside where the anticline enters Mineral County. Southwest of this locality it remains below the surface to the northern end of Abrams Ridge where it rises into a dome and is exposed for more than two miles along the ridge. After passing under a low saddle for several miles it again emerges with the rising structure at the northern end of the main ridge of New Creek Mountain 1½ miles northeast of Claysville and from this locality to the Grant County Line it forms the entire backbone of the mountain except at Dolls Gap where it has been cut entirely in two, exposing the Red Medina below it.

In Grant County, as shown by Map IV, the New Creek Mountain outcrop of the Medina continues southwestward, first making the conspicuous "Black Rocks" on the top of the ridge just south of the line, these being merely the white sandstone covered with a mass of black lichens which appear to characterize the exposures of the ledge at many other points. At Greenland Gap, North Fork of Patterson Creek has cut a great notch entirely through the White Medina and into the Red Medina below it, permitting both limbs of the arched formation to be well displayed on either limb of the anticline. At Cosner Gap Lunice Creek has done the same thing and at Kline Gap South Fork of Lunice Creek has created a similar exposure. At North Fork of South Branch of Potomac River where New Creek Mountain ends and North Fork Mountain begins, both being dissected parts of the original range, a much more spectacular outcrop of the White Medina is displayed. Here it makes the southern end of New Creek Mountain and the "Chimney Top" at the northern end of North Fork Mountain. From these two points the rocks dips rapidly eastward with the approximate slopes of the two mountains making visible escarpments both

north and south of the river which are each about 1½ miles long and which merge and pass under the river at the eastern end of North Fork Gap. On the west side of New Creek Mountain the Medina dips westward at a much more abrupt angle, varying from 50° to 80°, and crosses the highway one-third mile east of the mouth of Jordan Run and soon disappears beneath the flood-plain of North Fork. South of the immediate vicinity of North Fork the formation makes the escarpment along the ridge of North Fork Mountain from which it dips rapidly eastward going beneath the Clinton deposits one-half or three-fourths mile farther east and toward the foot of the mountain. On the upper western slope of this mountain the White Medina is completely eroded from the crest of the Wills Mountain Anticline but at about one-half mile west of the top of the mountain and one-fourth mile from the axis of the anticline the ledge may be seen projecting from many points along the mountainside and standing in an almost vertical position so that on this side the width of its outcrop is little more than the thickness of the ledge. The conditions described on either side of North Fork Mountain continue southward to the Pendleton County Line.

Along the Cave Mountain Anticline in the Smokehole Settlement, the top of the White Medina is exposed in the bluff just east of South Branch near the store of John Self and one-half mile northeast of Ketterman School; and it also occupies a larger area in the first large bend of the river just north of the Pendleton County Line but its full thickness is not exposed.

Along the Elkhorn Mountain Anticline in southeastern Grant, the White Medina forms the great Elkhorn Rock which is a conspicuous landmark along the ridge of Elkhorn Mountain. From this ridge it dips southeastward into Hardy County with the slope of the mountain and also northwestward into Grant, but in the latter county the outcrop is only about 1½ miles long, since the southward descent of the anticlinal axis confines it to a small triangle north of Elkhorn Run and near the top of the ridge. Just west of the Elkhorn Rock its full thickness has been eroded but its base is now concealed by debris.

CONTACTS, WHITE MEDINA SANDSTONE.

The upper contact of the White Medina with the Clinton Series has already been discussed, page 409, a subsidence of the sea bottom and a sudden check of the excess of sand-bearing fresh water so that normal marine conditions became possible in the latter formation being indicated. At the

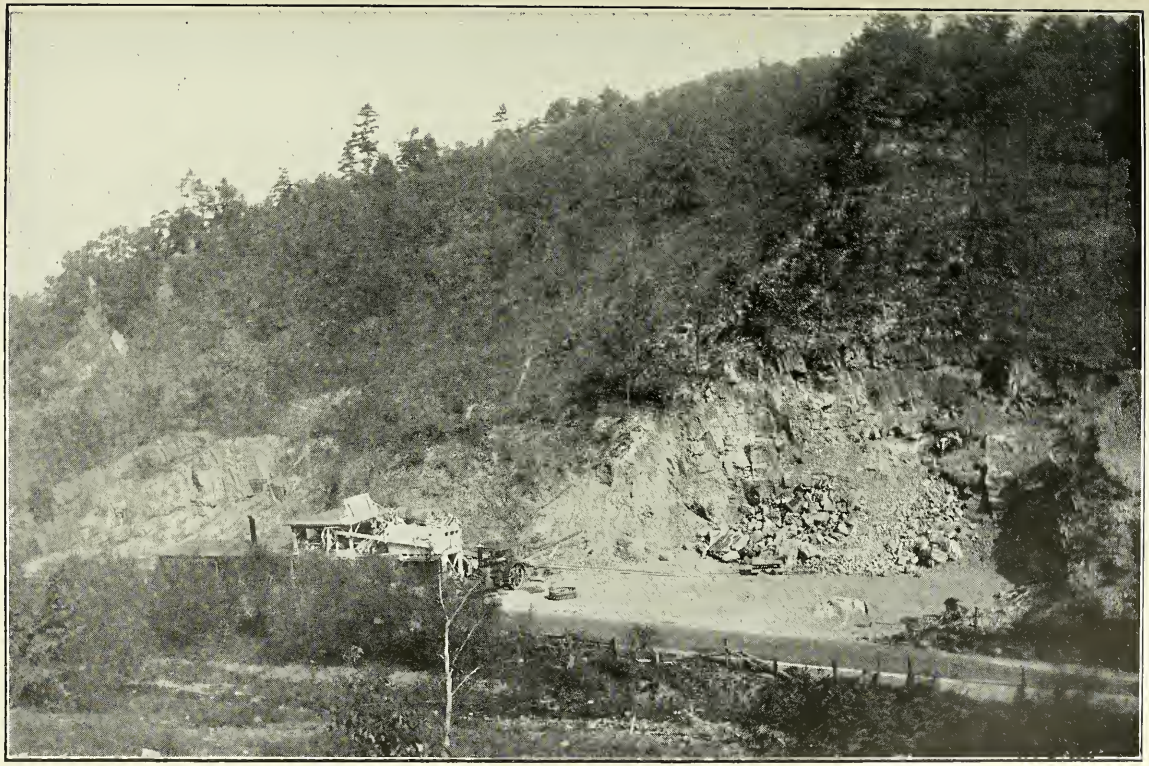

Photo by E. E. HARRIS.

PLATE XXIII.—Mineral County Road Quarry in gap of New Creek Mountain 1.5 miles northeast of New Creek town. Exposure at right is Helderberg Limestone, followed by New Scotland and Shriver Cherts behind crusher and by Oriskany Sandstone at left.

base of the White Medina it rests upon the Red Medina (Juniata) with an apparently plain lithologic unconformity. This contact is taken by many authors as the dividing line between the Ordovician and Silurian. An analysis of conditions that prevailed at this time, however, leads to the belief that diastrophism rather than a sustained time break was the chief factor in causing the abrupt change from the muddy, oxidized beds of the Red Medina to the pure white sand of the White Medina. It is apparent that the former was deposited in extremely shallow water which at some stages doubtless receded completely, allowing the accumulating beds to be exposed to the air and further that currents sufficiently strong to carry heavier sand grains and pebbles seldom, if ever, occurred. When White Medina time began, however, there must have been a sudden subsidence in the region of accumulation accompanied by abnormal precipitation in the area of erosion. The presence of the peculiar molds of **Arthrophycus** in both the White and Red Medinas largely precludes the idea of an extensive lapse of time so that these two formations may be regarded as only succeeding stages of a diastrophic cycle in which the sea was most shallow in Red Medina time and then became deeper until it reached a periodic maximum in late Clinton or Niagara time. In accordance with this view the West Virginia Survey prefers to include the Red Medina in the Silurian, as has already been discussed at some length in the Introduction to this Chapter, pages 357-362.

FOSSIL LIFE, WHITE MEDINA SANDSTONE.

In Mineral and Grant Counties no organic remains were noted in the White Medina. In adjoining areas, however, **Arthrophycus harlani,** considered by some authors as of vegetable origin and by others as the refilled trail of a crawling animal organism, has been often reported from this formation. **Scolithus** rods, or the filled-in cavities of worm burrows, are also frequently found in the Medina. No special search for either of these forms was made in the two counties. In New York State, Jomes Hall describes a scanty Silurian marine fauna as occurring in it.

SUBDIVISIONS, WHITE MEDINA SANDSTONE.

So far as known little or no attempt has been made to subdivide the White Medina Sandstone into stages or zones. Its lithologic content is continuous throughout and there is

an almost total absence of fossils, other than those mentioned above, so that its great mass must be regarded as simply a stratigraphic unit.

ECONOMIC ASPECTS, WHITE MEDINA SANDSTONE.

In the territory of this Report the White Medina offers almost nothing in the way of economic exploitation. In Ohio it is an oil and gas reservoir, erroneously termed the "Clinton" Sand, but as will be later discussed in Chapter XVI there is much reason to believe that it could not hold these substances in Mineral and Grant Counties. It would probably make a good grade of glass but its use in this industry would probably be too expensive both on account of the exorbiant cost of quarrying and crushing such a hard stone and because of the high fusing point its quartzitic nature would make. As a quarry stone for general building purposes it would prove almost indestructible against weathering but on account of its hardness it could scarcely be quarried and dressed in competition with more workable stone. As a base course for macadam highway construction or as concrete aggregate, however, it might be possible to utilize some of the great quantities of its debris from the Greenland, Cosner, Kline, and North Fork Gaps. It produces no agricultural soil, since its weathered content is almost pure sand.

At the following exposure in the Smokehole Settlement of Grant County along the eastern bluff of South Branch of Potomac River, 1.1 miles northeast of Ketterman Post-office and 0.5 mile north of the Pendleton County Line, on the land of Lucinda Nelson, the Medina contains some included yellow particles that have aroused local interest because of the belief that they were gold ore:

	Feet.
1. Sandstone, red, ferruginous, **Iron Sandstone**	25
2. Shale, sandy, and sandstone	15
3. Sandstone, very hard, white, with included yellow particles, **White Medina**, to bed of South Branch (1240′ B.)	20

The yellow particles, which are too small to reveal their crystallization under a hand lens or to give a satisfactory test for hardness, have the appearance of being iron pyrites, probably derived from infiltrating ferruginous water from the Iron Sandstone cliff. The locality is slightly less than one mile east of the overthrust fault which passes through the Smokehole Settlement but there is no indication of a fissure or intrusion here, such as would be expected in case gold were really present.

RED MEDINA SERIES.

GENERAL ACCOUNT, RED MEDINA SERIES.

The **Red Medina Series**, coming just under the White Medina and just above the Gray Medina Sandstone, is a group composed of shales and sandstones having a predominantly red color and being largely barren of organic remains. In the two counties it is fully exposed in the gap which North Fork of South Branch of Potomac River makes between the ends of New Creek and North Fork Mountains, 7 miles west of Petersburg, Grant County. Here it has a thickness of 1015 feet, as recorded in the Hopeville Section, page 177. The upper half is largely composed of brick-red shales, with streaks of greenish-red, micaceous, and cross-bedded sandstones, and the lower half is largely reddish or greenish-brown sandstones similar in character to those described above, occasionally interstratified with thin beds of red shale. In the Falls Section, page 175, the visible Red Medina of the Greenland Gap is 745 feet thick, its lower portion being below drainage and the upper part being less satisfactorily exposed than at North Fork Gap. In Cosner and Kline Gaps there are outcrops of the formation about equal to that in Greenland Gap but these are largely concealed by White Medina debris. In Mineral County the upper part outcrops in Dolls Gap of New Creek Mountain but the exposure is too poor for measurement. Just west of Cumberland, however, in Allegany County, Maryland, the series is again visible in the gap of Wills Creek Mountain where the beds are reported by O'Harra as 530 feet thick without evidence of a basal boundary being reached. In Bedford and Fulton Counties, Pennsylvania, just north of the Cumberland area, these beds are reported by Stevenson as 600? to 1200 feet thick. From all this evidence, therefore, it would appear that a thickness of 700 to 1100 feet in Mineral and Grant Counties is a fair estimate of the Red Medina.

The shales of this series are of a dull brick-red color, quite sandy and micaceous, with a somewhat irregular fracture, being neither fissile nor slickensided. There are occasional streaks of green which James Hall long ago described as due to the infiltration of carbonaceous water. The sandstones are highly cross-bedded and apparently lenticular. In physical appearance these rocks are an almost exact duplicate of the Catskill Series of the Upper Devonian and were evidently formed under similar conditions, being shallow-water deposits with much evidence of extensive oxidation caused by long stages of exposure, as further indicated by the general

absence of both fauna and flora neither of which could become well established in the oscillations of the ancient sea.

In many recent reports this group is described as the **Juniata** from exposures along the river of that name in Pennsylvania but there is no doubt that it is a portion of the Medina of the early New York Reports which was traced into eastern and central Pennsylvania and was there widely studied and described by Rogers, Lesley, White, Platt, Chance, Stevenson, and others who have all invariably described it as the Red Medina, or middle portion of the Medina Rocks. That being the case the introduction of the term "Juniata" appears to have been done without good reason.

TOPOGRAPHIC EXPRESSION, RED MEDINA SERIES.

The outcrop of the Red Medina is so limited in the two counties that it makes no full topographic forms from which a type may be described. At the few points where it is exposed, however, its shales and even most of its sandstones weather quite rapidly in sharp contrast to the White Medina above it.

AREAL EXTENT, RED MEDINA SERIES.

In Mineral County as shown by Map II, the only exposure of Red Medina is in Dolls Gap of New Creek Mountain just north of the Grant County Line, only its upper portion being exposed. In Grant County as shown by Map IV, the creeks at Greenland, Cosner, and Kline Gaps have cut through more than half of it, although it can not be easily studied owing to the great amount of debris from the White Medina. In North Fork Gap, however, its entire mass outcrops, the principal portion of which is exposed for examination. This outcrop continues southward along the axis of the Wills Mountain Anticline to the Pendleton County Line, with a length of more than five miles and a width of more than one-half mile but there are such vast masses of White Medina rubbish from the escarpment above that its study along this sector would be attended with great difficulty and lead to little tangible result. Along the western slope of the Elkhorn Mountain Anticline just west of the Elkhorn Rock in southeastern Grant, there is another small exposure of the upper portion but here also it has been almost entirely recovered by White Medina talus.

CONTACTS, RED MEDINA SERIES.

The upper contact of the Red Medina with the White Medina has already been discussed, page 417, the view being

taken that the abrupt change from red shales to white quartzite is caused by a comparatively sudden diastrophic subsidence and increase of precipitation rather than to a sustained time break. At its lower contact with the Gray Medina Sandstone the principal evidence of change that justifies the separation of the latter formation in North Fork Gap lies in the fact that red shales are totally absent in this lower group. The first appearance of red shale, in ascending order, has therefore been taken as the division-plane between the Gray and the Red.

FOSSIL LIFE, RED MEDINA SERIES.

The Red Medina has been generally described as unfossiliferous, although Bassler[29] affirms that actual tracing has proved it to be the lithologic equivalent of the fossiliferous Richmond Beds of Ohio. In Mineral and Grant Counties no fossils of any sort were observed in the Red Medina, but in the vicinity of Bluefield, southern West Virginia, as already stated in the Introduction to this Chapter, Dr. Prouty and the writer recently found **Arthrophycus** in these beds, as well as in the White Medina just above. That being the case a further search in both these formations in Mineral and Grant Counties would be of much interest because of the bearing this discovery has on the important question of the Silurian-Ordovician boundary.

SUBDIVISIONS, RED MEDINA SANDSTONE.

Little or no attempt at subdividing the Red Medina into subordinate members has been made, even in regions where there are extensive outcrops and good exposures, the view being taken that its sandstones are apt to be lenticular and incapable of being traced owing to the general absence of fossils in them and in the shales. In Mineral and Grant Counties the outcrops of the formation are so few and unsatisfactory that no attempt at subdivision would be justifiable, since no stratum named could be traced the necessary distance to establish individuality. The writer, however, prefers to reserve for the present any opinion on the practicability of dividing this group of rocks.

ECONOMIC ASPECTS, RED MEDINA SERIES.

The Red Medina Series of the two counties contains little that could be classed as of present known economic

[29] R. S. Bassler, Cambrian and Ordovician Deposits of Maryland, Maryland Geological Survey, p. 171; 1919.

value. Its sandstones in general are too shaly to make good building stone and its shales contain too many included lenses and strata of sand to make their utilization as brick material an easy matter. It is probable, though, that these shales would make a fair agricultural soil if free from the White Medina rubbish that usually covers them.

GRAY MEDINA SANDSTONE.

GENERAL ACCOUNT, GRAY MEDINA SANDSTONE.

The **Gray Medina Sandstone,** coming just below the Red Medina and lying just above the Martinsburg Shales, is exposed only on the waters of North Fork of South Branch of Potomac River in Grant County. It is entirely displayed in North Fork Gap on the south side of the river just east of the axis of the Wills Mountain Anticline, being 254 feet thick, as recorded in the Hopeville Section, page 177. Its upper portion is somewhat shaly but below this zone it becomes more compact with only occasional thin streaks of gray shale. It is greenish-gray with specks of brown iron oxide, medium-hard and medium-coarse, there being some thin quartz veins along slickensided surfaces, showing a marked beginning of metamorphism.

The Gray Medina is the lower group of the Medina Rocks of Pennsylvania as there subdivided in general accordance with the early classification in New York State. In the Potomac region of West Virginia it appears to coincide more closely with the standard section of Pennsylvania than it does with that of New York, the three divisions in the latter State being less clearly defined than in the former. In the Pennsylvania Reports the Gray Medina is usually called the Oneida Conglomerate, or "Gray Oneida" in the evident belief that the Oneida of New York was the same as the lower division of the Pennsylvania Medina. Bassler, however, states that the Oneida has been proved to belong at the top of the Medina or possibly in the basal Clinton, but that the Gray Medina is identical with, or at least occupies the position of, the Oswego Sandstone of New York which, he says, actually underlies the Red Medina. If that be true the use of the term "Oneida" in describing the Gray Medina might be confusing, although it is preserved by Clarke and Schuchert in the current nomenclature of the Silurian of New York, as indicated in the republication of their section in the Introduction to this Chapter, page 359. In this section the "Medina Sandstone" is recorded as the upper division, followed by the "Oneida Conglomerate," of which latter the Shawangunk is listed as a subdivision.

The relationship of the Gray Medina of the Potomac region to the Shawangunk of New York State is not entirely clear. In Report G6, pages 150-151, of the Second Geological Survey of Pennsylvania, Dr. I. C. White describes this formation as the "Oneida Conglomerate," saying that it occurs at the base of the Medina below the red members and that it outcrops on Blue Mountains which are called Shawangunk in New York State; and he further states that the Hudson River Slates immediately underlie this conglomerate. Darton, also, in the 47th Annual Report of the New York State Museum, pages 501-504, describes the Shawangunk as resting on the Hudson River Shales and as being overlain by red beds, but in Ulster County, to which his Report applies, the upper divisions of the Medina are poorly represented so that correlations are uncertain. Inasmuch as the Gray Medina of the Potomac region also rests upon the Hudson River (Martinsburg) Shales and comes just under the Red Medina the evidence distinctly favors its correlation with the Shawangunk.

In the "Cambrian and Ordovician Deposits of Maryland," page 170, Bassler also correlates the Gray Medina of the Appalachian region with the Upper Maysville (McMillan) of Ohio, which, in Reports of the latter State, is described as containing abundant marine fossils in the Cincinnati region. The fossils of the Upper Maysville are Ordovician but in the Potomac region no fauna of Ordovician age is found except entirely below the base of the Gray Medina where the lower Maysville fossils occur. There being no fossils of any sort in the Gray Medina, it would appear more logical to suppose that the Upper Maysville beds were entirely absent rather than to consider them the equivalent of the former formation.

TOPOGRAPHIC EXPRESSION, GRAY MEDINA SANDSTONE.

In Mineral and Grant Counties the Gray Medina was studied only in North Fork Gap where it occurs in the steep bluff of North Fork of South Branch. Being largely composed of fairly hard sandstone it should make rough topography in regions of more extensive outcrop.

AREAL EXTENT, GRAY MEDINA SANDSTONE.

In Mineral County the Gray Medina does not outcrop. In Grant County, as shown by Map IV, it is above drainage in North Fork Gap where the Wills Mountain Anticline crosses North Fork of South Branch of Potomac River, there being a small belt of it surrounding a small central mass of Martinsburg Shale. Farther south along the same anticline there should be some small areas of it on the heads

of short tributaries of North Fork which cut deep gullies in the western slope of North Fork Mountain, since the axis of the arch is known to be rising southward. No study of these isolated deposits was made.

CONTACTS, GRAY MEDINA SANDSTONE.

The upper contact of the Gray Medina with the Red Medina has been discussed, page 417, the beginning of red shales being assumed as the end of the Gray formation. At its base the Gray Medina rests upon a dark, shaly sandstone containing fossils of Ordovician age, there being a slight but clearly perceptible angular unconformity at this division-plane. In passing from this lower group up into the Gray Medina, the end of a long period of uninterrupted marine sedimentation and the beginning of another epoch of lacustrine, estuarine, or possibly in part continental deposition began, there being both a lithologic and faunal unconformity, since the first fossils found in higher rocks are Silurian types. This plane is therefore taken as the Ordovician-Silurian boundary.

FOSSIL LIFE, GRAY MEDINA SANDSTONE.

In sharp contrast to the Martinsburg Shale just below it, no fossils of any sort were observed in the Gray Medina Sandstone. Their absence appears to mark the beginning of the comparatively long time interval during which the three divisions of the Medina were deposited under waters of a less saline character.

SUBDIVISIONS, GRAY MEDINA SANDSTONE.

So far as known no attempt has been made to subdivide the Gray Medina into smaller units. In Grant County its outcrop is too limited to justify any conclusions in this respect in the present Report.

ECONOMIC ASPECTS, GRAY MEDINA SANDSTONE.

Being almost entirely composed of sandstone without any included minerals, the Gray Medina appears to have no present economic interest, although its outcrops, if more favorably situated, might be utilized in a small way for building stone. As a source of agricultural soil it has no appreciable value.

CHAPTER XV.

STRATIGRAPHY---ORDOVICIAN ROCKS.

INTRODUCTION.

In Mineral and Grant Counties only about 300 feet of Ordovician Rocks, as herein classified, are exposed. In Chapter XIV the base of the Silurian has been drawn at the base of the Gray Medina Sandstone, thereby putting all three divisions of the Medina in that system contrary to the views of some good authorities who prefer to place the contact at the junction of the White Medina with the Red Medina (Juniata). As previously discussed in detail, the Red Medina is linked with the White Medina by the presence of **Arthrophycus** in both groups and the Gray Medina is cut off from close association with the underlying Martinsburg Shale by the sudden cessation of all marine life at the end of the latter, making it appear reasonably plain that the three Medinas are disconnected by no major unconformity, and since the White Medina in New York State contains a limited Silurian fauna the same classification should apply to them all.

The Ordovician as thus limited is found above drainage only on the waters of North Fork of South Branch of Potomac River in Grant County, its best exposure being in North Fork Gap near the axis of the Wills Mountain Anticline. Farther south along the same anticline these rocks are reported in the Franklin Folio by Darton as outcropping in certain ravines tributary to North Fork but the latter outcrops were not inspected by the writer. All of these outcrops belong to the upper portion of the Martinsburg Shale, corresponding in some measure with the Hudson River Shales of the early New York classification.

MARTINSBURG SHALE.

GENERAL ACCOUNT, MARTINSBURG SHALE.

The shales described by Darton (Amer. Geol., Vol. X, p. 13) as the Martinsburg are limited by the statement that they

"Succeed the Shenandoah Limestone with a thin series of alternating thin-bedded limestones and slates at their base. The name is taken from Martinsburg, in the Shenandoah Valley, in West Virginia, a region in which the formation is extensively and typically exposed. . . . . The rocks are slates and shale, mainly of dark color . . . . The beds are fossiliferous at many points; graptolites are found in the basal beds. Along Little North Mountain, and in the Warm Spring, Crab Bottom, and other anticlinal valleys westward, remains of Upper Ordovician brachiopods are moderately abundant. The forms most frequently met with are, **Leptaena sericea, L. alternata, Orthis testudinaria, O. pectinella, and Modioiopsis modiolaria.** The precise equivalency of the formation is not known, but judging from its general relations and fauna, it probably comprises the Utica, Hudson River, and possibly small amounts of adjacent formations of the New York series. It is No. III of Rogers' reports and has generally been called the Hudson River."

With the lower limit of the Martinsburg the present Report has no concern, since the total thickness of the shales is reported by various investigators in the Potomac region as varying from 1000 to 3000 feet and by Darton in particular as being 1100 to 1500 feet in the territory of the Franklin Folio which includes a portion of Grant County. Of these beds there is a maximum of only about 300 feet above drainage in North Fork Gap while only 74 feet of the upper portion are exposed to view, the remainder being covered by debris.

The correlation of the Martinsburg with the formations of similar age in other regions, with the exception of the outcropping Grant County beds, is also a problem that need not be discussed at length in this Volume, but the following statement by R. S. Bassler in the "Cambrian and Ordovician Deposits of Maryland," page 163, is of interest:

"Although fossils must be considered as quite rare in the Martinsburg Shale, sufficient paleontologic evidence has been found to show that faunas of Trenton, Eden, and Maysville age are represented. Two zones with Trenton fossils occur near the base of the formation, the Eden fauna is found in the upper sandy portion, and the topmost sandstones hold Maysville species."

The reported scarcity of fossils in the Martinsburg of Maryland, as also confirmed by other observers in the Potomac region, is in sharp contrast to the appearance of the top of these beds in Grant County where marine fossils occur in great abundance. Along the New River drainage of southern West Virginia, also, where the full thickness of Martinsburg is exposed, almost every inch of the formation is so abundantly marine that all stages of its outcrop must be examined to obtain representative faunas. In this latter area Dr. Prouty and the writer have recently made very full col-

lections so that when the identifications of these fossils are finally published in the forthcoming Report on Mercer, Monroe, and Summers Counties it is hoped that the relationship of the West Virginia phase of the Martinsburg to the equivalent formations in regions of earlier study may be definitely established.

In North Fork Gap the visible portion of the Martinsburg is composed of shaly or friable sandstones of a general brownish-black color and much brecciated and slickensided by the crushing action of the anticlinal flexure. Their relationship to the overlying Medina beds is indicated in the Hopeville Section, page 178. They are best exposed in the bluff along the south side of North Fork one mile east of the mouth of Jordan Run and 2.7 miles southwest of Corners, or 7 miles west of Petersburg.

TOPOGRAPHIC EXPRESSION, MARTINSBURG SHALE.

The limited outcrop of Martinsburg Shale in the two counties gives little idea of the topographic form it might assume if it covered a wider territory. Bassler, however, states that it forms a low plateau through the Appalachian Valley, being more resistant than the subjacent limestones. In Grant County its upper portion is sufficiently siliceous that it should not rapidly erode.

AREAL EXTENT, MARTINSBURG SHALE.

As previously stated, the Martinsburg covers a small area in the valley of North Fork of South Branch of Potomac River at the axis of the Wills Mountain Anticline. Farther southward along the same arch it is reported by Darton as outcropping in some of the ravines tributary to North Fork. No attempt was made to study these isolated exposures in detail, since there are other more extensive areas immediately southward in Pendleton County where more satisfactory sections can be made.

CONTACTS, MARTINSBURG SHALE.

The upper contact of the Martinsburg Shale with the Gray Medina Sandstone of the Silurian, has already been described under the latter formation, page 424. It is therein indicated that a small but noticeable angular unconformity occurs at this plane and there is a change from brownish-black, friable sandstone to a hard, gray sandstone. The most marked feature, however, is the utter absence of marine

fossils in the Gray Medina as compared to their abundance in the Martinsburg. The basal contact of the Martinsburg with older rocks was nowhere exposed in the two counties.

FOSSIL LIFE, MARTINSBURG SHALE.

In North Fork Gap the visible portion of the Martinsburg, including 74 feet of rocks, is abundantly fossiliferous, the upper 62 feet having numerous **Lingula nicklesi** and other more sparing forms, while the lower 12 feet is characterized by a great profusion of **Orthorhynchula linneyi,** together with other types. No hint of the fossil life in the lower 222 feet (estimated) of outcropping but concealed beds could be had. In the exposed portion one collection of fossils, made by the writer, was identified by Dr. Tilton, and another, made by Scheffel, Price, and the writer, was examined by Dr. Prouty. Both lists are published in Chapter XXI, the conclusion being that the collections represent rocks of Lower Maysville age, the type section of which is at Maysville, Kentucky, near the Cincinnati Anticline.

The following is a summarized list of all fossils identified by Drs. Tilton and Prouty from the exposed portion (Lower Maysville beds) of the Martinsburg Shale in Grant County:

Orthorhynchula linneyi (James)
Modiolodon truncatus (Hall) ?
Modiolodon truncatus (Hall)
Modiolopsis sp.
Modiolopsis modiolaris (Conrad)
Byssonychia praecursa (Ulrich)
Byssonychia or Allonychia ? (6 fragments)
Lingula sp. fragments
Lingula nicklesi (Bassler)
Tetranota sp. near T. obsoleta
Ctenodonta cf. gibberula (Salter)
Ctenodonta cf. obliqua
Ctenodonta obliqua
Nuculites sp. near N. neglecta
Nuculites sp.
Protowarthia sp.
Orthoceras lamellosum (Hall)
Cyrtolites close to inornatus (Hall)
Sedgwichia close to compressus (Meek)
Callopora sp.
Ischyrodonta unionoides (Meek)
Pelecypod fragments (2 new genera)
Pelecypod fragments
Gastropods (3 imperfect specimens).

SUBDIVISIONS, MARTINSBURG SHALE.

The Maysville beds of the Cincinnati region are listed by Fenneman[1] as follows in descending order:

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[1]N. M. Fenneman, Geology of Cincinnati and Vicinity, Geological Survey of Ohio, 4th Ser., Bull. 19, p. 59; 1916.

Formation	Member	Thickness in Feet	Character
McMillan formation	Mt. Auburn concretionary shale	20 to 35	Blue shale with irregular or concretionary beds of limestone.
	Corryville shale	35 to 50	Shale with thin beds of limestone.
	Bellevue limestone	0 to 23	Very fossiliferous limestone.
Fairview formation	Fairmount limestone	70 to 85	Predominantly limestone with subordinate shale.
	Mt. Hope shale	16 to 50	Predominantly shale, but containing many beds of limestone.

In North Fork Gap the visible beds being of Lower Maysville age would therefore appear to represent in part at least the Fairview Formation of the above classification, but their correlation with the minor subdivisions is not clear. It is not believed, however, that they reach to the bottom of Dr. Fenneman's Mt. Hope Shale, since this is described as having great multitudes of **Dalmanella multisecta** in a thin zone at the base, but these are not found in North Fork Gap. The upper 62 feet of the Martinsburg on North Fork may with propriety be styled the **Lingula nicklesi Zone** and the lower 12 feet the **Orthorhynchula linneyi Zone** from the abundance of the two fossils mentioned in the respective positions. This Lingula is found sparingly in the lower zone but the Orthorhynchula does not appear to extend to the upper beds.

ECONOMIC ASPECTS, MARTINSBURG SHALE.

No economic importance is attached to the Martinsburg Shale of Grant County, since it does not appear to contain mineral substances of value. In regions of more extensive outcrop it makes a fairly good agricultural soil, depending on the local percentage of limestone.

PART III.

Mineral Resources.

CHAPTER XVI.

PETROLEUM AND NATURAL GAS.

GENERAL STATEMENT.

Mineral and Grant Counties lie 50 to 60 miles east of the main oil- and gas-producing belt of the State. The most western point of Grant County is approximately 45 miles east of the nearest oil pool at Shinnston, Harrison County, and the most eastern point in Mineral County is about 85 miles from the same pool; and the respective distances of these two points from the nearest commercial gas well in Barbour County are about 26 and 70 miles. In the intervening territory several wells, some of which have been deep tests, have been drilled, resulting in dry holes or only slight pockets of gas with rare shows of oil. Between these two counties and the commercial oil and gas fields, moreover, the huge Deer Park Anticline, passing southwestward across Garrett County, Maryland, and Preston, Tucker, Randolph, and other West Virginia counties, brings above the surface nearly all the known productive oil and gas sands of the State so that the same sands in Mineral and Grant Counties have no physical connection with the known productive region. Some deeper horizons not yet proved to be productive in the western part of the State may exist as continuous sheets of sand eastward into the two counties but little present significance may be attached to these deposits.

In Mineral County one shallow hole has been drilled near Piedmont and another of greater depth has been completed near Headsville, while a third test has been made in Allegany County, Maryland, just west of Cumberland and only a few miles from the Mineral Line. In Grant County no tests have been made but two comparatively deep wells have been drilled along North Branch of Potomac in Garrett County, Maryland, near Steyer and Gorman, while in Pendleton County, lying south of Grant a hole has been drilled at Riverton on North Fork of South Branch of Potomac. In all of these wells no commercial production was found, there being some reported shows of oil and gas, as will be later detailed.

As a prospective oil or gas region the two counties are favored by the presence of the Pennsylvanian, Mississippian, Devonian, Silurian, and Ordovician Rocks, the shales and limestones of which are known to contain abundant vegetable and animal remains from which oil and gas are admittedly distilled. They are further favored by folding which has developed well-defined anticlinal and synclinal structure so that any liquid hydrocarbon formed at an early age could have been fully segregated into pools. In many other fundamental conditions, however, they are lacking. Except in the region west of the Allegheny Front the Pennsylvanian, Mississippian, and Devonian beds that produce oil and gas in abundance in the western part of the State have been elevated so high that their principal sands have been either eroded completely or outcrop at the surface so that complete evaporation would be possible. A further condition of vital importance is that the folding which formed the various ridges of the Alleghenies has been so severe that incipient metamorphism has taken place, which, with its attendant great heat and pressure, may have completely volatilized the hydrocarbons, causing their escape from the rocks in gaseous form. It has been established by Dr. David White of the United States Geological Survey that oil is seldom found in regions where the coals have extremely low volatile and high carbon content, and that gas in such localities is less abundant than in areas where the relative percentage of carbon is smaller, the explanation being that the analysis of the coal reveals the extent to which metamorphism has advanced and gives a criterion by which the same process in the petroleum hydrocarbons may be roughly measured. A carbon ratio for any

point may be obtained by dividing the fixed carbon of the proximate analysis of a local coal by the sum of the fixed carbon and the volatile matter of the same analysis, which gives the total carbon contained in the coal on a moisture- and ash-free basis. "Isocarbs", or lines of equal carbon, may then be obtained by computing the carbon ratios for many points of a given area so that lines of average equal content may be drawn across the map of the territory so that for any position the approximate ratio is available. A map of this sort recently prepared for the whole State of West Virginia by the writer has shown rather conclusively that oil is found in the State principally in regions where the isocarbs indicate a ratio of less than 60, there being a few good pools between 60 and 65, and that gas in quantity has seldom been found where the ratio is above 70.

In Mineral and Grant Counties a computation of the carbon ratios of the Upper Freeport Coal by Tucker shows that they vary in general from 77 to 83 which is much greater than that of any of the known oil and gas fields of the State. This factor alone would indicate that the presence of either oil or gas in commercial quantity is extremely doubtful. These products are so widely found in West Virginia, however, that a report on the mineral resources of a county is hardly complete without the presentation of data to guide the oil prospector in case he prefers to drill in such territory. A brief discussion of the oil sands of the State and an outline of the most favorable structural locations, together with such well records as are available, will therefore be given.

OIL AND GAS HORIZONS.

The following classification of the various oil and gas sands of the State, taken with slight revisions from former Reports of the Survey, gives the productive horizons of other counties, including some that have produced oil in northwestern Pennsylvania but may not have yet yielded commercial quantities in West Virginia, as well as the deeper horizons of Ohio and Kentucky some of which are now being sought for at great expense in the northern part of the State. In this table the sands are grouped under formation names, the titles in use by the drillers being given the preference, followed in most cases by their recognized geologic equivalents:

Photo by E. E. HARRIS.

PLATE XXIV.—Home of George E. Leps Heirs in Keyser. This house was built of Helderberg Limestone in 1817, the material coming from the Joseph Arnold Quarry described in text. There is little sign of disintegration.

Oil and Gas Horizons of West Virginia.

Pennsylvanian:

Monongahela Series	Carroll Sand (Uniontown).
Conemaugh Series	Minshall Sand (Connellsville). Murphy Sand (Morgantown). Moundsville Sand (Saltsburg). First Cow Run (Little Dunkard) Sand (Buffalo). Big Dunkard Sand (Mahoning).
Allegheny Series	Burning Springs Sand (Upper Freeport). Gas Sand of Marion and Monongalia Counties (Lower Freeport).
Pottsville Series	Second Cow Run Sand of Ohio (Homewood). Cairo Gas Sand. Cairo Salt Sand. Cairo ? Rosedale Gas Sand (Guyandot). Rosedale Salt Sand (Sharon Conglomerate).

Mississippian:

Mauch Chunk Red Shale Series	Princeton Conglomerate. Maxton, Dawson, Cairo. Little Lime.
Greenbrier Limestone	Big Lime.
Pocono Sandstone Series	Keener Sand and Beckett Sand of Milton. Big Injun Sand. Squaw Sand. Weir Sand. Berea Sand.

Devonian:

Catskill Red Beds	Gantz Sand. Fifty-foot Sand. Thirty-foot Sand. Gordon Stray Sand. Gordon Sand. Fourth Sand. McDonald or Fifth Sand. Bayard or Sixth Sand. Elizabeth or Seventh Sand (Hendricks).
Chemung and Portage Beds	Warren First Sand. Warren Second (Burnside?) Sand. Clarendon or Tiona Sand. Speechley Sand. Balltown or Cherry Grove Sand. Sheffield or Cooper (Riley?) Sand. Benson, Bradford? or Deer Lick Sand. Elk or Waugh and Porter Sand. Kane Sand.

Hamilton and Marcellus	Gas in Ohio and Kentucky.
Corniferous (Columbus) Limestone	Ragland, Menefee, or Irvine Sand of Kentucky.
Oriskany Sandstone	Oriskany Sand.
Silurian:	
Helderberg, (Devonian), Salina, and Niagara	"Big Lime" of Ohio (Newberg Sand near middle).
Medina White Sandstone	Clinton Sand of Ohio.
Ordovician:	
Martinsburg or Cincinnati Shale	Hudson Sand Group of Kentucky.
Trenton and Other Limestones	Trenton Sand Group of northern Ohio.

In Mineral and Grant Counties the known productive sands of the Monongahela Series do not exist at all as they belong above the tops of the mountains. Only small areas of the upper Conemaugh sands remain and the lower portions of this series outcrop so widely and are so exposed to evaporation that they offer no inducement to the prospector. In the Allegheny Series, also, the sands are never more than a few hundred feet deep, but in the Pottsville they have more cover in portions of the North Potomac Valley. The Mauch Chunk, Greenbrier, Pocono, and Catskill are buried rather deeply under the North Potomac Syncline but outcrop west of it along the western slope of Backbone Mountain and east of it along the eastern side of the Allegheny Front. From the base of the Catskill upward to the highest sands named in the table all these horizons have been entirely eroded in the region east of the Allegheny Front so that they may be found only on the western side of this range.

The sands of the Chemung would be found in the region west of the Allegheny Front but eastward they lie on the surface in some of the synclines and are completely eroded over many of the anticlines, the same statement being true of the Portage and other lower formations in the Devonian. The Silurian formations would be deeply buried in the region west of the Allegheny Front but eastward they are above drainage in many localities. In the Ordovician only the top of the Martinsburg Shale is exposed in southern Grant County, this and the Trenton being elsewhere buried under cover.

In the region west of the Allegheny Front an intelligent idea of the structure and position of the sands may be gained from the structure contours on the Upper Freeport ("Davis",

"Split-six") Coal as published on Maps II and IV, and from this datum plane the depth to the top of each geologic group may be roughly figured from the General Columnar Section, Figure 5, pages 85-87, the Upper Freeport Coal being at the top of the Allepheny Series. In the region east of the Allegheny Front no structure contours have been prepared on any datum, the dips being much too abrupt for this method of representation, but frequent cross-sections appear on Maps II and IV from which the depths to the various formations may be estimated.

In the Monongahela, Conemaugh, and Allegheny the sands are too near the surface to be of any interest. In the Pottsville the sands are thick and porous and physically capable of holding liquids or gases in large quantity. In the Mauch Chunk they are fine-grained and lenticular and the Princeton Sandstone seems to have disappeared almost completely. The Greenbrier Limestone is hard and compact and generally quite lacking in pore space. In the Pocono there are several coarse sands that could serve as reservoirs. The Catskill is greatly expanded as compared to its occurrence in the oil fields of the western counties, there being numerous lenticular sandstones some of which are fairly porous. In the Chemung there are two or three fairly constant conglomeratic beds that could act as reservoirs, but in the Portage, Genesee, Hamilton, and Marcellus the shales do not contain thick sandstones. The Corniferous Limestone appears to be entirely absent, there being a compact limestone (Lower Selinsgrove) in the same shale group that would hardly hold liquid. The Oriskany Sandstone is a coarse and porous bed with a good thickness of 50 to 150 feet and would be an excellent container, but the Helderberg, Bossardville, and Rondout Limestones are compact and lacking in pore space. There is a sandstone in the Bloomsburg Shale of the Salina Formation but it is quite compact. The Niagara beds are composed of shaly limestone which would probably hold little liquid. In the Clinton Series which comes between the Niagara and the White Medina there is a heavy ferruginous sandstone near the base which should have pore space. The White Medina Sandstone, which is believed to be the "Clinton Sand" of Ohio, has a thickness of 200 to 300 feet but is quite compact and would be a doubtful reservoir. In the Red Medina and Gray Medina, lying below the White, there is an abundance of sandstone. The Martinsburg Shale is composed of shaly and friable sandstone at the top, its lower portion being probably shale or shaly limestone. The Trenton Limestone is generally considered as a part of the Martins-

burg Shale Group. The sands lying below the Chemung and Portage beds have been tested but little in any of the known productive pools of West Virginia, their classification as possible oil reservoirs being made on the basis of their petroleum and gas content in other States.

WELL RECORDS, MINERAL COUNTY.

Within the bounds of Mineral County only two wells have been drilled for oil but a third is located in Maryland near the county line and is of some value.

The **Cumberland Well (No. 1 on Map II)**, located in Allegany County, Maryland, about 1½ miles northwest of the central portion of Cumberland, its more immediate position being on the west side of Wills Creek just north of the Standard Oil Company of New Jersey supply station, was drilled 15 to 20 years ago. The location selected was one-third mile southeast of the axis of the Wills Mountain Anticline, the surface elevation being 625′ B., and the outcropping rocks being in the Red Medina Series. A careful hand-level measurement from the well mouth up to the base of the White Medina cliff on the eastern side of the creek and along the strike of the rocks shows that the well starts 257 feet below the base of this rock. According to report it was drilled 500 to 600 feet deep which would make its bottom 750 to 850 feet below the base of the White Medina or probably in the top of the Martinsburg Shale, since available evidence leads to the belief that the Red Medina is hardly more than 600 to 700 feet thick in that locality. The hole was abandoned as a failure, although a little gas was found as may be verified by inspection, there being now a four-inch pipe in the ground at the mouth of which the escaping gas can be lighted. A painstaking attempt was made to secure the detailed record but it could not be found, but the two following letters from Mr. R. H. McCleave, of Cumberland, Md., and Mr. F. A. Trieber, of Buckhannon, W. Va., who were concerned in drilling the well, are of interest:

"Replying to your letter of the 6th. inst., will say.

"The only information I can give you regarding the old well drilled on Wills Creek is that it was drilled to a depth of about five or six hundred feet, showing some gas, but the drilling was abandoned for lack of funds.

"If you will write to Mr. Frank Trieber, Buckhannon, W. Va., who was one of the persons in charge of the drilling, no doubt he can furnish all the information you desire.

"Very truly yours,

(Signed) R. H. McCLEAVE."

"Referring to yours December 12th in regard to well drilled at Cumberland, Md., regret to advise that I am not able to locate the records kept of the well. Can say, however, that we had no showing of either oil or gas worth speaking of. The rock while not burned was hard and owing to troubles with drillers never reached the Gordon sandstone.

"Mr. Matthew H. Sloan, Cumberland, Md., kept a record of well and no doubt he can advise more fully on this.

"Regretting that I can not supply the information desired, I am.

"Yours very truly,

(Signed) F. A. TRIEBER."

A letter addressed to Mr. Sloan at Cumberland was not answered and the search for the record was abandoned. The statement of Mr. Trieber that the hole did not reach the Gordon Sand is misleading, since the well starts many thousand feet below this horizon which is in the Catskill Series of the Upper Devonian. If this well had been drilled on the axis of the arch it would have started several hundred feet deeper in the rocks and would have been a more favored location for gas. Such a location in this gap would probably penetrate all of the Martinsburg Shale, including the Trenton Limestone, at a depth of less than 3,000 feet, and would be of great scientific interest, although it could not be advised as a commercial venture.

The **George Biser No. 1 Well (No. 2 on Map II)**, located in Cabin Run District, Mineral County, on a short branch of Patterson Creek, 1.8 miles southwest of Headsville, was drilled by Col. J. M. Guffey, Mr. J. W. Scott, and associates, of Pittsburgh, Pennsylvania, eight or ten years ago. The surface elevation is 720′ B., the surface outcrop is the Hamilton Shale and the structural position is about midway between the Tussey Mountain Anticline and Russelldale Syncline, there being a southeast dip of 23°. There is a light stream of clear sulphur water flowing from a six-inch pipe that still remains in the hole but no evidence of gas or oil. An inquiry at the office of Mr. Guffey in Pittsburgh gained the information that the record of this hole was regarded as of such little interest that it had not been preserved. According to Mr. Biser the well was drilled about 3,000 feet deep and had neither oil nor gas. Mr. Robert Leatherman, of Junction, who was an interested party, states that it was drilled 3,200 feet deep and did not get into limestone, which would indicate that the Helderberg Limestone was not penetrated.

The location of this well is reported to have been made on the strength of a supposed seepage of oil on a branch of Staggs Run 2 miles southwest of Headsville and 1 mile northwest of the Biser well, and almost immediately on the

axis of the Bean Cove Syncline. A visit to this spring in August, 1921, however, revealed the apparent fact that an impregnation of red sulphur in the water, with its accompanying slime, had been mistaken for oil.

The **New Creek Coal and Iron Company No. 1 Well (No. 3 on Map II)**, located on the south side of North Branch of Potomac River, one-third mile northeast of Hampshire, Piedmont District, Mineral County, was drilled between the years 1860 and 1865, according to report. Little information could be secured about it except that it was drilled with a spring-pole and was necessarily shallow. Its surface elevation is 980′ B., and it starts in the Allegheny Series just below the level of the Upper Kittanning Coal which is opened on the opposite side of the river at an elevation of 990′ B., the drill site being almost directly on the axis of the North Potomac (Georges Creek) Syncline. So far as known no record of this well is available.

PROSPECTIVE GAS AREAS, MINERAL COUNTY.

For reasons previously named it is not believed that commercial quantities of oil will be found in Mineral County, and for the same reasons it is regarded as extremely doubtful whether any appreciable amount of gas still remains in the rocks. Because of the fact that horizons in which the latter is known to occur in other regions are present in the county, however, it is thought proper to name the various localities at which tests might be made to best advantage. It may be stated in general that the synclinal areas are not considered worthy of attention, since the only rocks easily accessible to the drill along them invariably outcrop on the anticlines a short distance away where evaporation would presumably remove all their original oil and gas content. Along the anticlines, however, there is a remote possibility that sands or other porous horizons in the Martinsburg Shale, with its included Trenton Limestone, may contain some deposits of gas, since these lower beds are fully exposed to the air only in the extreme eastern counties of the State.

In Frankfort District the Helderberg Limestone is exposed along the axis of the Tussey Mountain Anticline just east and south of Patterson Depot, the high part of the dome being at the summit of Patterson Creek Ridge, 2½ miles south of the depot while the most easily accessible drill site would be along the Baltimore and Ohio Railroad just east of the mouth of Patterson Creek. A test could be made at less cost in the latter location and would be of the same value, since any gas contained under the dome should extend as

far north as the Potomac. At this locality the White Medina Sandstone should be reached at about 1,800 feet and a total depth of slightly less than 5,000 feet should complete a test to the base of the Martinsburg and Trenton formations.

In the same district, on the Wills Mountain Anticline, a test drilled in the vicinity of Riverside on North Branch of Potomac River would start on the outcrop of the White Medina ("Clinton Sand") and should penetrate the basal Martinsburg and Trenton beds at 3,000 to 3,500 feet.

In New Creek District, on the Wills Mountain Anticline, a test in Dolls Gap of New Creek Mountain would start in the Red Medina, about 350 feet below the base of the White Medina, and should reach the base of the Martinsburg and Trenton at about 3,000 feet, but the location would be expensive on account of natural obstacles.

WELL RECORDS, GRANT COUNTY.

In Grant County no wells have been drilled for oil and gas, but two tests along its northwestern border have been made and a third has been drilled some miles southwestward. No commercial production is reported in any of these wells. The two following tests, recently drilled on the Maryland side of North Branch of Potomac near Steyer and Gorman, afford valuable information not only on the oil sands but on the coals as well, their records having been carefully kept by Mr. William Hickman of the Hickman-Holt Drilling Company, Fairmont, West Virginia, who drilled them for the Potomac Oil & Gas Corporation and to whom the Survey is indebted for their use in this volume:

Bayard Coal Company No. 1 Well Record (4).

Ryan Glades Township, Garrett County, Maryland, on north side of North Branch of Potomac River just west of Steyer; authority, Potomac Oil & Gas Corporation; completed, July 3, 1920; elevation, 2350′ B.

	Thickness. Feet.	Total. Feet.
Gravel, surface, yellow	20	20
Sandstone, gray	3	23
Shale, brown	19	42
Coal, Upper Kittanning	3	45
Shale, brown	20	65
Coal, Lower Kittanning, (hole full of water at 66′)	8	73
Shale, brown	22	95
Limestone, very hard	20	115
Sandstone, **Homewood**	63	178
Shale, black	22	200
Shale, brown	17	217

	Thickness. Feet.	Total. Feet.
Limestone, black	43	260
Sandstone	18	278
Shale, black	9	287
Sandstone	4	291
Shale, black	69	360
Slate, black	40	400
Sandstone, very hard	63	463
Slate, black	4	467
Limestone	3	470
Coal, fine quality, **Sewell (Sharon?)**	4	474
Slate, black	15	489
Sandstone, gray, Salt Sand	19	508
Slate, black	6	514
Sandstone, gray	86	600
Shale, red	95	695
Limestone, shell, very hard	4	699
Shale, red	167	866
Sandstone, gray, **Maxton** (little showing of oil)	5	871
Slate, black, Pencil Cave	3	874
Limestone 30′ Slate, black 2 Limestone 34 Slate, black 1 Limestone 24 Limestone, gritty 25 Limestone, bottom of Big Lime 70 — **Big Lime (Greenbrier)**	186	1060
Shale, red	190	1250
Sandstone, gray, very hard, Big Injun? or Squaw?	10	1260
Red rock	140	1400
Sandstone, gray, Weir	80	1480
Red rock	8	1488
Sandstone, white, Berea	12	1500
Red rock	18	1518
Shale, red, lime shells	37	1555
Red rock	16	1571
Sandstone, gray	29	1600
Sandstone, black, very hard	30	1630
Slate, black	15	1645
Limestone, black	35	1680
Sandstone, gray	100	1780
Shale, red	120	1900
Red rock	38	1938
Shale, red	12	1950
Sandstone, gray	50	2000
Red rock	25	2025
Shale, red	75	2100
Red rock	4	2104
Sandstone, gray, Gordon?	12	2116
Red rock	6	2122
Sandstone, gray, Gordon?	8	2130
Shale, red	6	2136
Sandstone, gray, Gordon?	14	2150
Shale, red	65	2215
Limestone, gritty, extremely hard	25	2240

"Knocked pin off of stem; left pin and stem in hole; pulled all casing, except 10-inch.

"Conductor, 8 feet; 10" casing, 75'; 8¼" casing, 620'; 6⅝" casing, 1460'.

"When 8¼-inch casing was lifted sufficient gas had collected to throw water out of hole for 45 minutes, but whether gas came from sandstone or coal it could not be determined."

The above well starts between the Upper and Lower Freeport Coals and on the structural slope between the Blackwater Anticline and North Potomac (Georges Creek) Syncline. It was abandoned as a dry hole, there being a small showing of oil in the Maxton Sand as indicated and apparently a little gas in this or some other unknown horizon.

John Nydegger No. 1 Well Record (5).

Ryan Glades Township, Garrett County, Maryland, on Nydegger Run of North Branch of Potomac River, 0.4 mile northwest of Gorman; authority, Potomac Oil & Gas Corporation; completed, November 19, 1921; elevation, 2360' B.

	Thickness. Feet.	Total. Feet.
Surface gravel, yellow	18	18
Shale, blue	12	30
Shale, white	20	50
Sandstone, gray, Saltsburg	26	76
Coal, Bakerstown (Thomas)	4	80
Shale, white	31	111
Limestone	15	126
Shale, white	20	146
Shale, brown	12	158
Shale, white	42	200
Sandstone, gray, Lower Mahoning	57	257
Coal 4' / Shale, blue 3 / **Coal** 4 — **Upper Freeport, "Davis," "Split-Six"**	11	268
Shale, white	44	312
Sandstone, gray, Lower Freeport	40	352
Coal, Upper Kittanning	3	355
Shale, white	15	370
Shale, brown, broken	45	415
Limestone	10	425
Sandstone, gray, Homewood	70	495
Shale, blue, broken	15	510
Slate, black	30	540
Limestone	12	552
Shale, brown	8	560
Limestone	15	575
Shale, brown	20	595
Limestone	20	615
Slate, black	45	660
Sandstone, gray	12	672
Shale, brown	58	730
Sandstone, gray	55	785
Slate, black	27	812
Sandstone, gray, and lime	88	900
Shale, blue	6	906

	Thickness. Feet.	Total. Feet.
Slate, red, shelly	284	1190
Sandstone, gray	8	1198
Pencil Cave?	2	1200
Lime	68	1268
Shale, blue	15	1283
Shale, red	111	1394
Shale, blue	6	1400
Lime, **Little Lime**	16	1416
Shale, blue 18′ Red rock 6 Lime, gritty 40′ Shale, red 10 Lime, gritty 10 Shale, red 12 Lime 81	Pencil Cave 24 **Big Lime** (Greenbrier) 153	1440 1593
Red rock	13	1606
Sandstone, gray, Big Injun	18	1624
Red rock	36	1660
Limestone	20	1680
Shale, red	12	1692
Red rock	8	1700
Sandstone, yellow, Weir	16	1716
Shale, white	2	1718
Shale, red	25	1743
Limestone	55	1798
Sandstone, dark, **Berea?** (showing oil in top)	17	1815
Red rock	10	1825
Shale, red	35	1860
Lime, gritty	50	1910
Slate	6	1916
Lime, dark	6	1922
Shale, blue	5	1927
Lime, gritty	48	1975
Shale, blue	30	2005
Limestone, gritty	20	2025
Shale, blue	7	2032
Limestone, gritty	28	2060
Shale, blue	20	2080
Red rock, hard	6	2086
Shale, red	6	2092
Red rock	8	2100
Shale, red, and shells	214	2314
Red rock	15	2329
Shale, red	16	2345
Shale, white	32	2377
Sandstone, gray, soft	8	2385
Shale, red	35	2420
Red rock	48	2468
Sandstone, gray	30	2498
Shale, red	8	2506
Red rock	9	2515
Sand	20	2535
Shale, red	17	2552
Sand, Gordon?	33	2585
Red rock, very hard	17	2602
Sand, gray (show of water)	38	2640
Red rock	11	2651

	Thickness. Feet.	Total. Feet.
Shales, red, and shells	24	2675
Red rock, very hard	12	2687
Shale, red	13	2700
Red rock	23	2723
Sand, gray (showing oil in top)	21	2744
Red rock, hard	57	2801
Sand	8	2809
Shale, red	15	2824
Red rock	206	3030
Sand	25	3055
Red rock	10	3065
Red rock	29	3094
Sand	11	3105
Red rock	75	3180
Shale, red	12	3192
Sand, gray	12	3204
Shale, red	6	3210
Red rock	30	3240
Shale, red	12	3252
Sand, gray	6	3258
Shale, red	5	3263
Red rock	22	3285
Shale, red	7	3292
Red rock	18	3310
Sand, gray	12	3322
Red rock	13	3335
Sand, green	14	3349
Red rock	31	3380
Sand	22	3402
Red rock	5	3407
Sand	23	3430
Shale, red	15	3445
Sand, gray, Elizabeth (Hendricks)?	10	3455
Slate	11	3466
Sand, gray, hard	23	3489
Slate	7	3496
Sand, gray, hard	4	3500

The above well is also situated between the Blackwater Anticline and North Potomac Syncline, but is lower down the slope than the Bayard Coal Company well. The position of the Bakerstown Coal in the record would indicate that the surface formation is the Pittsburgh Red Shale, there being no visible outcrop. In what appears to be the Berea Sand there was a show of oil and another was found in a sand at 2723 feet, the identity of which may be only conjectured. It comes in the Catskill Series of red beds, however, which is limited by the base of the Berea and the base of the Elizabeth Sand and which therefore has a total thickness of 1640 feet in this well, if the assumption of the writer as to the location of these two sands be correct. This thickness of the Catskill compares with a total of only 400 to 600 feet for the same series in the oil fields of the western counties

and a thickness of 1925 feet as measured at Keyser. It will be readily seen that no correlation of the intermediate sands of this series in the Nydegger well would be dependable, but the Elizabeth horizon is fairly well fixed by the change from red to the gray beds of the Chemung immediately below it.

The record of the **Clara Harper No. 1 Well,** drilled by the North Fork Oil and Gas Company at Riverton, Pendleton County, on North Fork of South Branch of Potomac River about 15 miles from the Grant County Line, has been published on page 272 of the Tucker County Report of the Survey, its total depth on July 1, 1919, being 1850 feet. It is understood that some further drilling at this hole has been done but the additional record is not available. As pointed out in the Tucker County Report this well is located on the western slope of the Wills Mountain Anticline on beds that dip at an angle of about 75°, the surface formation being the Marcellus Shale of the Devonian. Owing to the steep dip the record is of little value for stratigraphic purposes and is not herein repeated. Apparently neither oil nor gas had been found on the date mentioned.

PROSPECTIVE GAS AREAS, GRANT COUNTY.

In Grant County the same remarks and caution about making useless tests along the synclines as written above with reference to Mineral County should closely apply.

In Grant District three convenient locations for testing the deep horizons are afforded along the Wills Mountain Anticline by Greenland, Cosner, and Kline Gaps, at all of which holes could be started in the Red Medina beds, 600 to 700 feet below the base of the White Medina and should reach through the Martinsburg and Trenton at about 3,000 feet. In the same district a test located on the axis of the Patterson Creek Mountain Anticline where it crosses a short tributary of Patterson Creek 1 mile southeast of Williamsport would start in the Clinton Series and should reach the base of the Martinsburg and Trenton at 3,500 to 4,000 feet.

In Milroy District, a test located on the axis of the Wills Mountain Anticline at North Fork Gap, 7 miles west of Petersburg, would start approximately 300 feet below the top of the Martinsburg Shale and should reach the base of this formation and the Trenton Limestone at less than 2,000 feet, and could if desired be drilled into the Shenandoah Limestone which in some regions is dolomitic and therefore porous, but is not so reported by Darton in the Franklin Folio along the same anticline farther south. In the same district a well located on the Cave Mountain Anticline just

north of the Pendleton County Line in the Smoke Hole Settlement would start on the outcrop of the White Medina Sandstone and should reach through the Martinsburg and Trenton with about 3,000 feet of drilling, but the broken condition of the rocks on account of the overthrust fault just to the westward might cause the loss of the hole. In the same district a location on the outcrop of the Red Medina could be made along or near the axis of the Elkhorn Mountain Anticline just west of the Elkhorn Rock and would test a great dome, but the cost of transporting materials to this isolated spot would be very great.

In Union District, the eastern line of which is with the ridge of New Creek Mountain and is therefore about coincident with the axis of the Wills Mountain Anticline, the remarks made under Grant District concerning tests in Greenland, Cosner, and Kline Gaps closely apply, since both districts share the Red Medina outcrops and anticlinal structure in these gaps. West of the Allegheny Front the Blackwater Anticline extends through Union District but its axis rises rapidly southward and reaches the crest of a huge dome in the Canaan Valley of Tucker County, as described in the Tucker County Report, so that any testing for gas done on this anticline should start on the Tucker County dome where the Pocono Sandstone (Big Injun Sand) outcrops. This latter locality is regarded by the writer with far more favor for obtaining gas than any location mentioned in either Mineral or Grant Counties.

CHAPTER XVII.

COMMERCIAL COAL.

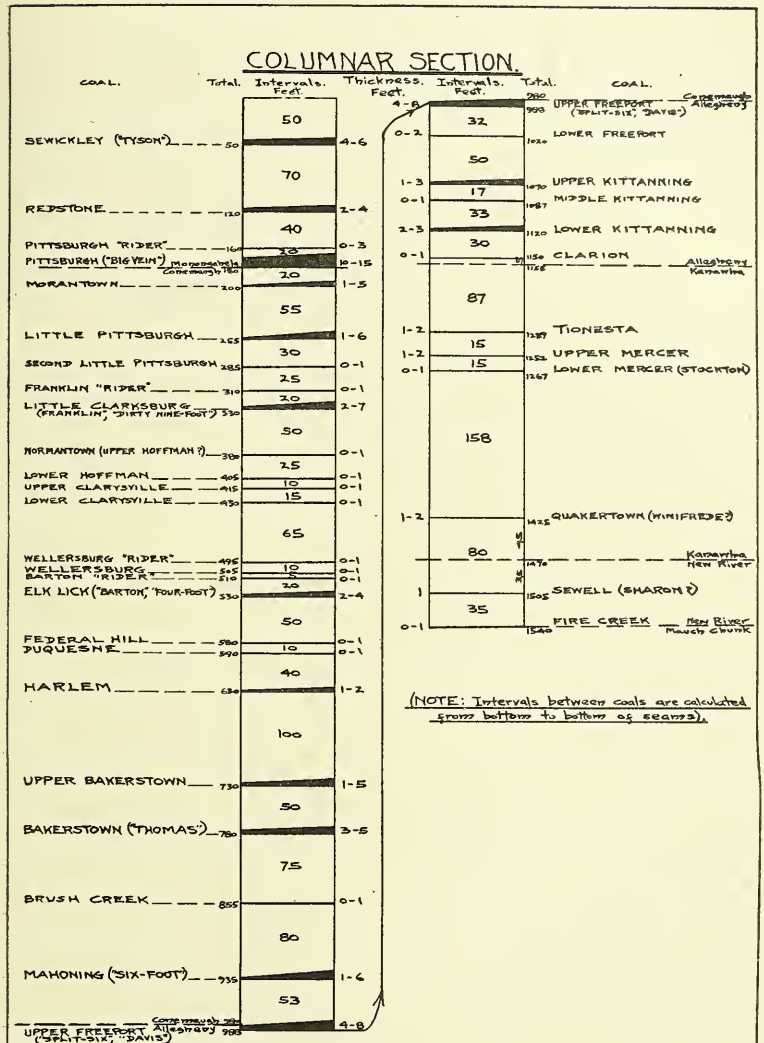
GENERAL STATEMENT

I Chapters VI to IX, inclusive, a systematic description of all the coal seams found in Mineral and Grant Counties has been given, together with their correlations. Many of the beds are too thin, lenticular or impure to be of commercial rank and all such have been fully described in the Chapters named, measured sections at openings and prospects being detailed. In the present Chapter numerous actual measured sections will be published for those coals that are of minable thickness and purity and estimates of their probable tonnage, with etchings showing their areal extent, will be given.

In these two counties there are 13 coals that appear to have minable thickness and 23 others too thin, impure, or irregular to be of more than local value, some of these latter being thin beds that are of scientific interest only. The minable seams, in descending order, are the Sewickley ("Tyson"), Redstone and Pittsburgh ("Big Vein") of the Monongahela Series; the Little Pittsburgh, Little Clarksburg ("Dirty Nine-foot", "Franklin"), Elk Lick ("Four-foot", "Barton"), Harlem, Upper Bakerstown, Bakerstown ("Thomas"), and Mahoning ("Six-foot") of the Conemaugh Series; and the Upper Freeport ("Split-six", "Davis"), Upper Kittanning, and Lower Kittanning of the Allegheny Series. The Pottsville coals do not appear to have minable value.

Figure 9 shows the different coal seams of the two counties, giving not only their relative thickness, but also the maximum interval (base to base) between them. Figures 10 to 27, inclusive, published in the present Chapter, will show, approximately, where the commercial seams occur in possible minable thickness in each county.

In general the coals of the two counties are of low-volatile, bituminous rank, being sold mainly to the eastern



(NOTE: Intervals between coals are calculated from bottom to bottom of seams).

FIGURE 9.—DIAGRAM SHOWING RELATIVE POSITION OF COAL SEAMS (MINERAL AND GRANT COUNTIES).

R.C.T.

trade as smokeless coal, and used largely for steam and domestic fuel, and to a more limited extent in metallurgical industries. In sulphur, phosphorus, and ash they vary from high to low grade and in the fusing point of ash the same statement is true. The latter quality varies inversely as the sulphur, a high sulphur content being invariably followed by a low fusing point which causes objectionable clinkering.

STATISTICS OF COAL PRODUCTION.

In Mineral County commercial coal mining has been followed for many years, production being confined to the drainage area of North Branch of Potomac River in Piedmont and Elk Districts. Coals ranging from the Pittsburgh down to the Lower Kittanning have been exploited, but at present the principal production is from the Elk Lick, Bakerstown, Mahoning, and Upper Freeport seams. In the Pittsburgh, or "Big Vein", as it is commonly known among the miners, the larger operations have been abandoned, owing to the nearly exhausted condition of the deposit which occurs only in the tops of a few hills. Mining is carried on by drift entries, exclusively, no attempt having been made to operate any seam lying below drainage. No coke is produced.

In Grant County the State Department of Mines first reports commercial tonnage for the year 1903, which appears to represent the beginning of the industry. At the present time mining is confined to the Bakerstown ("Thomas") and Upper Freeport ("Split-six", "Davis") Coals, but there were formerly operations in the Pittsburgh and Little Pittsburgh in Fairfax Knob where small areas of these two seams occur. Like Mineral County, coal occurs principally along the drainage basin of North Branch of Potomac River, in Union District. Mining is done by drift, slope, and shaft, the valleys of the Potomac and its major tributaries being not nearly so deep, and making it necessary to sink shafts in some parts of the county to reach the coal. No coke is produced, but some of the coal is used elsewhere in by-product plants.

The following tables, assembled by Tucker from statistics given in the Annual Reports of the West Virginia Department of Mines, and supplemented by unpublished data from Mr. R. M. Lambie, present Chief, give the coal production of Mineral County for the past 34 years and of Grant for the past 19 years, together with their relative orders in production as compared to other counties, and the yearly production of coal by mines in Mineral County since 1897 and by mines in Grant County since 1903:

Coal Production.

(Fiscal years end June 30 of each year).

Year	MINERAL COUNTY			GRANT COUNTY		
	Long tons	Short tons	Order	Long tons	Short tons	Order
1888	468,618	524,852.16	4	.....	.....	....
1889	453,365	507,768.80	4	.....	.....	....
1890	512,217	573,683.04	4	.....	.....	....
1891	623,067	697,835.04	6	.....	.....	....
1892	473,862	530,725.44	6	.....	.....	....
1893	557,488	624,386.56	6	.....	.....	....
1894	489,808	548,584.96	6	.....	.....	....
1895	614,780	688,553.60	6	.....	.....	....
1896	554,492	621,031.04	6	.....	.....	....
1897	537,169	601,629.28	7	.....	.....	....
1898	510,757	572,047.84	7	.....	.....	....
1899	554,286	620,800.32	6	.....	.....	....
1900	562,667	630,187.04	8	.....	.....	....
1901	513,772	575,424.64	8	.....	.....	....
1902	552,181	618,442.72	9	.....	.....	....
1903	514,582	576,331.84	11	28,489	31,907.68	22
1904	467,613	523,726.56	11	113,969	127,645.28	18
1905	505,171	565,791.52	12	167,053	187,099.36	19
1906	540,147	604,964.64	13	228,837	256,297.44	19
1907	607,172	680,032.64	14	271,542	304,127.04	20
1908	622,295	696,970.04	13	242,442	271,535.04	20
1909	745,658	835,136.96	11	177,406	198,694.72	20
1910	858,672	961,712.64	13	217,499	243,598.88	21
1911	615,059	688,866.08	15	221,462	248,037.44	21
1912	655,941	734,653.92	17	188,907	211,575.84	23
1913	703,550	787,976.00	16	178,378	199,783.36	24
1914	688,172	770,752.64	16	189,746	212,515.52	24
1915	556,350	623,112.00	17	165,121	184,935.52	24
1916	639,341	716,061.92	18	178,420	199,830.40	26
1917	697,242	780,911.04	20	267,269	299,341.28	25
1918	781,348	875,109.76	20	263,653	295,291.36	25
1919	462,253	517,723.36	21	122,476	137,173.12	29
1920	466,029	521,952.48	23	236,187	264,529.44	27
1921	367,148	411,205.76	23	242,712	271,837.44	26
Totals	19,472,272	21,808,944.64		3,701,568	4,145,756.16	

Coal Tonnage Produced in Mineral and Grant Counties by the Various Mines for the Year Ending June 30, 1921.

NAME OF COMPANY	NAME OF MINE	PRODUCTION OF COAL (Tons of 2,240 lbs.)			DISTRIBUTION OF COAL (Tons of 2,240 lbs.)		
		First Six Months.	Second Six Months.	Total Coal Produced During Year.	Used in Operation of Mine.	Furnished Local Trade and Tenants.	Quantity Shipped from Mines.
MINERAL COUNTY							
Abrams Creek Coal & Coke Co.	Abrams Creek No. 1	30,571	213	30,784	960	120	29,704
Bakertown Coal Co.	Arthur	144	.....	144	.....	.....	144
Carroll-Cross Coal Co.	Cross & Imperial	18,807	1,053	19,860	.....	.....	19,860
Clise Bros. Coal Co.	Bakertown	9,570	.....	9,570	150	.....	9,420
Davis Coal & Coke Co., The	Virginia No. 10	11,397	8,763	20,160	.....	147	20,013
Dean Coal Co., The	Dean No. 1	9,799	329	10,128	174	.....	9,954
Dean Coal Co., The	Dean No. 2	17,223	5,809	23,032	.....	346	22,686
Deep Run Big Vein Coal Co.	Grant	8,462	.....	8,462	.....	300	8,162
Deep Run Big Vein Coal Co.	Lantz	6,768	.....	6,768	.....	.....	6,768
Fortney & Pyles	Barrick	5,046	.....	5,046	.....	.....	5,046
Glade Run Coal & Coke Co.	Florence	1,781	79	1,860	.....	.....	1,860
Gleason Coal & Coke Co.	Gleason Nos. 1 & 3	35,414	17,411	52,825	1,257	682	50,886
Grafton Mining Co.	Wabash No. 1	4,003	.....	4,003	.....	.....	4,003
Grafton Mining Co.	Wabash No. 2	4,806	275	5,081	34	.....	5,047
H. P. Brydon & Bro., Inc.	Big Vein	13,370	.....	13,370	250	.....	13,120
H. P. Brydon & Bro., Inc.	Four Foot	6,432	6,840	13,272	197	.....	13,075
Jaffy Coal Mining Co.	Swayne	10,362	.....	10,362	.....	.....	10,362
Kalbaugh Coal Co. Inc., The	Kalbaugh	8,700	530	9,230	.....	.....	9,230
Low Volatile Collieries Co.	Low Volatile No. 1	4,927	189	5,116	115	.....	5,001
Mapleville Coal Co.	Mapleville	3,665	5,576	9,241	.....	.....	9,241
Masteller Coal Co., The	Hampshire Nos. 4 & 5	16,355	10,544	26,899	205	216	26,478
Masteller Coal Co., The	New Creek	17,844	1,726	19,570	82	.....	19,488
Pritts Brothers Coal Co.	Pritts Brothers	7,825	2,021	9,846	50	.....	9,796
Silver Coal Co.	Hampshire No. 11	35,000	500	35,500	500	50	34,950
Smith Big Vein Coal Co.	Smith	205	3,596	3,801	.....	6	3,795
St. Cloud Coal Mining Co.	St. Cloud No. 1	6,188	243	6,431	.....	.....	6,431
Sunn Coal Co.	Enterprise	500	.....	500	.....	.....	500
Twin Mountain Coal Co.	Fahey	6,287	.....	6,287	147	.....	6,140
Totals		301,451	65,697	367,148	4,121	1,867	361,160
GRANT COUNTY							
Davis Coal & Coke Co., The	No. 22	55,692	37,907	93,599	2,541	472	90,586
Emmons Coal Mining Co. of West Virginia, The	Culpepper No. 1	80,655	64,855	145,510	4,585	481	140,444
Jordan, S. H.	Jordan	1,595	2,008	3,603	290	25	3,288
Totals		137,942	104,770	242,712	7,416	978	234,318

Coal Tonnage Produced in Mineral and Grant Counties by the Various Mines for the Year Ending June 30, 1920.

NAME OF COMPANY	NAME OF MINE	PRODUCTION OF COAL (Tons of 2,240 lbs.)			DISTRIBUTION OF COAL (Tons of 2,240 lbs.)		
		First Six Months.	Second Six Months.	Total Coal Produced During Year.	Used in Operation of Mine.	Furnished Local Trade and Tenants.	Quantity Shipped from Mines.
MINERAL COUNTY							
Abrams Creek Coal & Coke Co.	Oakmont No. 1	28,566	37,837	66,403	2,060	257	64,086
Bakertown Coal Co.	Bakertown	1,717	51	1,768	.....	.....	1,768
Carroll-Cross Coal Co.	Cross & Imperial	15,361	17,966	33,327	.....	.....	33,327
Davis Coal & Coke Co., The	Virginia No. 10	5,130	10,284	15,414	.....	98	15,316
Dean Coal Co., The	Dean No. 1	2,882	9,087	11,969	498	.....	11,471
Dean Coal Co., The	Dean No. 2	2,755	9,804	12,559	.....	328	12,231
Deep Run Big Vein Coal Co.	Grant	7,821	11,281	19,102	.....	.....	19,102
Deep Run Big Vein Coal Co.	Lantz	13,988	1,678	15,666	300	350	15,016
Emory Run Coal Co.	Emory Run	.....	6,000	6,000	30	21	5,949
Fortney & Pyles	Barrick	2,057	4,048	6,105	52	112	5,941
Glade Run Coal & Coke Co.	Florence	1,600	1,180	2,780	.....	.....	2,780
Gleason Coal & Coke Co.	Gleason Nos. 1 & 2	31,481	36,546	68,027	1,524	1,464	65,039
Grafton Mining Co.	Wabash No. 2	5,184	7,776	12,960	.....	225	12,735
H. P. Brydon & Bro., Inc.	Big Vein	13,495	15,062	28,557	476	.....	28,081
Jaffy Coal Mining Co.	Patton	20,311	8,995	29,306	.....	200	29,106
Jaffy Coal Mining Co.	Swayne	5,359	9,396	14,755	.....	.....	14,755
Kalbaugh Coal Co., Inc.	Kalbaugh Nos. 1 & 2	.....	2,500	2,500	.....	.....	2,500
Low Volatile Collieries Co.	Low Volatile No. 1	3,380	7,068	10,448	360	200	9,888
Mapleville Coal Co.	Mapleville Nos. 1 & 2	1,600	2,831	4,431	70	.....	4,361
Masteller Coal Co., The	Hampshire Nos. 4 & 5	21,693	17,854	39,547	217	104	39,226
Masteller Coal Co., The	New Creek	12,505	17,047	29,552	101	.....	29,451
Silver Coal Co.	Nos. 1, 2, 3, & 4	.....	31,322	31,322	.....	.....	31,322
St. Cloud Coal Mining Co.	St. Cloud No. 1	1,161	2,370	3,531	.....	.....	3,531
Totals		198,046	267,983	466,029	5,688	3,359	456,982
GRANT COUNTY							
Davis Coal & Coke Co., The	No. 22	58,731	50,621	109,352	3,275	505	105,572
Emmons Coal Mining Co. of West Virginia, The	Culpepper No. 1	73,708	49,746	123,454	3,497	1,250	118,707
Jordan, S. H.	Jordan	2,252	1,129	3,381	.....	200	3,181
Totals		134,691	101,496	236,187	6,772	1,955	227,460

Coal Tonnage Produced in Mineral and Grant Counties by the Various Mines for the Year Ending June 30, 1919.

NAME OF COMPANY	NAME OF MINE	PRODUCTION OF COAL (Tons of 2,240 lbs.)			DISTRIBUTION OF COAL (Tons of 2,240 lbs.)		
		First Six Months.	Second Six Months.	Total Coal Produced During Year.	Used in Operation of Mine.	Furnished Local Trade and Tenants.	Quantity Shipped from Mines.
MINERAL COUNTY							
Abrams Creek Coal & Coke Co.	Oakmont No. 1	43,465	12,446	55,911	1,693	366	53,852
Bakertown Coal Co.	Bakertown	3,191	331	3,522	.....	.....	3,522
Carroll-Cross Coal Co.	Black Diamond & Imperial	18,168	3,728	21,896	.....	.....	21,896
Davis Coal & Coke Co., The	No. 6	8,971	1,724	10,695	.....	336	10,359
Davis Coal & Coke Co., The	No. 10	12,203	1,871	14,074	.....	91	13,983
Davis Coal & Coke Co., The	No. 11	.....	679	679	3	.....	676
Davis Coal & Coke Co., The	No. 19	19,322	2,335	21,657	282	99	21,276
Davis Coal & Coke Co., The	No. 20	10,393	838	11,231	.....	.....	11,231
Davis Coal & Coke Co., The	No. 50	12,529	2,233	14,762	143	207	14,412
Davis Coal & Coke Co., The	No. 51	23,015	4,792	27,807	286	74	27,447
Deep Run Big Vein Coal Co.	Grant	7,214	1,720	8,934	.....	.....	8,934
Deep Run Big Vein Coal Co.	Lantz-Walreece	27,418	13,303	40,721	200	100	40,421
Emory Run Coal Co.	Emory Run	8,484	2,966	11,450	89	.....	11,361
Glade Run Coal & Coke Co.	Florence	3,201	2,847	6,048	.....	.....	6,048
Gleason Coal & Coke Co.	Gleason Nos. 1 & 3	34,251	22,448	56,699	1,404	2,061	53,234
Grafton Mining Co.	Freeport No. 6	3,972	1,681	5,653	.....	.....	5,653
Grafton Mining Co.	Kittanning No. 2	7,245	4,535	11,780	.....	85	11,695
Hamill Coal & Coke Co.	Smith	4,256	2,544	6,800	.....	.....	6,800
H. P. Brydon & Bro., Inc.	Big Vein	15,618	3,360	18,978	.....	.....	18,978
Jaffy Coal Mining Co.	Patton	14,670	10,181	24,851	.....	792	24,059
Jaffy Coal Mining Co.	Swayne	7,236	1,946	9,182	.....	.....	9,182
Low Volatile Collieries Co.	Low Volatile No. 1	8,584	1,595	10,179	150	350	9,679
Mapleville Coal Co.	Mapleville	2,400	180	2,580	40	.....	2,540
Masteller Coal Co.	Hampshire Nos. 4 & 5	17,672	21,236	38,908	176	180	38,552
Masteller Coal Co.	New Creek	17,815	3,014	20,829	70	.....	20,759
Piedmont Coal Corporation	Fahey	6,427	.....	6,427	64	.....	6,363
Totals		337,720	124,533	462,253	4,600	4,741	452,912
GRANT COUNTY							
Davis Coal & Coke Co., The	No. 22	79,283	35,069	114,352	3,360	292	110,700
Emmons Coal Mining Co. of West Virginia, The	Culpepper No. 1	2,447	2,295	4,742	3,300	300	1,142
Jordan, S. H.	Jordan Nos. 1 & 2	2,594	788	3,382	.....	.....	3,382
Totals		84,324	38,152	122,476	6,660	592	115,224

Coal Tonnage Produced in Mineral and Grant Counties by the Various Mines for the Year Ending June 30, 1918.

NAME OF COMPANY	NAME OF MINE	PRODUCTION OF COAL (Tons of 2,240 lbs.)			DISTRIBUTION OF COAL (Tons of 2,240 lbs.)		
		First Six Months.	Second Six Months.	Total Coal Produced During Year.	Used in Operation of Mine.	Furnished Local Trade and Tenants.	Quantity Shipped from Mines.
MINERAL COUNTY							
Abrams Creek Coal & Coke Co.	Oakmont No. 1	49,078	41,473	90,551	2,225	489	87,837
Bakertown Coal Co.	Bakertown	4,905	3,640	8,545	.....	.....	8,545
Carroll-Cross Coal Co.	Imperial & Black Diamond	20,726	19,461	40,187	.....	.....	40,187
Davis Coal & Coke Co., The	No. 6	11,110	7,608	18,718	.....	406	18,312
Davis Coal & Coke Co., The	Windom No. 10	.....	8,738	8,738	.....	18	8,720
Davis Coal & Coke Co., The	No. 14	1,017	.....	1,017	.....	2	1,015
Davis Coal & Coke Co., The	No. 19	26,115	20,113	46,228	594	198	45,436
Davis Coal & Coke Co., The	No. 50	15,230	12,056	27,286	459	269	26,558
Davis Coal & Coke Co., The	No. 51	29,520	21,904	51,424	666	216	50,542
Davis Coal & Coke Co., The	Ott No. 20	13,978	10,116	24,094	.....	.....	24,094
Dean Coal Co.	Ott No. 20	14,844	10,412	25,256	300	.....	24,956
Deep Run Big Vein Coal Co.	Grant	9,368	8,741	18,109	.....	.....	18,109
Deep Run Big Vein Coal Co.	Lantz-Walreece	4,286	1,101	5,387	.....	.....	5,387
Deep Run Big Vein Coal Co.	Lantz	21,851	23,184	45,035	300	300	44,435
Glade Run Coal & Coke Co.	Florence	4,999	4,224	9,223	.....	.....	9,223
Gleason Coal & Coke Co.	Gleason No. 1	37,000	37,808	74,808	1,048	2,014	71,746
Hamill Coal & Coke Co., The	Smith, Poca, Manor No. 2	14,125	7,586	21,711	.....	.....	21,711
H. P. Brydon & Bro., Inc.	Big Vein	15,732	11,725	27,457	.....	125	27,332
Jaffy Coal Mining Co.	Bakerstown	2,406	3,741	6,147	.....	.....	6,147
Jaffy Coal Mining Co.	Patton	18,012	19,945	37,957	.....	320	37,637
Low Volatile Collieries Co., Inc.	Low Volatile No. 1	5,550	11,191	16,741	300	135	16,306
Mapleville Coal Co.	Mapleville	2,742	2,591	5,333	30	30	5,273
Masteller Coal Co., The	Hampshire Nos. 2, 3, 4, & Whisner Hill	28,994	25,542	54,536	213	200	54,123
Masteller Coal Co., The	New Creek	31,995	28,519	60,514	95	.....	60,419
Piedmont Coal Co.	Fahey	14,657	6,456	21,113	.....	400	20,713
Western Maryland Coal Co.	Freeport No. 6	9,619	6,128	15,747	.....	.....	15,747
Western Maryland Coal Co.	Kittanning No. 2	11,315	8,171	19,486	.....	180	19,306
Totals		419,174	362,174	781,348	6,230	5,302	769,816
GRANT COUNTY							
Davis Coal & Coke Co., The	No. 22	68,042	70,334	138,376	4,016	281	134,079
Emmons Coal Mining Co. of West Virginia, The	Culpepper No. 1	60,000	60,000	120,000	1,200	600	118,200
S. H. Jordan	Cottage Street & Jordan	3,461	1,816	5,277	.....	218	5,059
Totals		131,503	132,150	263,653	5,216	1,099	257,338

Coal Tonnage Produced in Mineral and Grant Counties by the Various Mines for the Year Ending June 30, 1917.

NAME OF COMPANY	NAME OF MINE	PRODUCTION OF COAL (Tons of 2,240 lbs.)			DISTRIBUTION OF COAL (Tons of 2,240 lbs.)		
		First Six Months.	Second Six Months.	Total Coal Produced During Year.	Used in Operation of Mine.	Furnished Local Trade and Tenants.	Quantity Shipped from Mines.
MINERAL COUNTY							
Abrams Creek Coal & Coke Co.	Oakmont No. 1	21,525	41,563	63,088	1,291	275	61,522
Bakertown Coal Co.	Bakertown	2,016	5,896	7,912	.....	.....	7,912
H. P. Brydon & Bro., Inc.	Big Vein	5,706	14,281	19,987	235	.....	19,752
Carroll-Cross Coal Co.	Black Diamond & Imperial	30,105	26,287	56,392	.....	.....	56,392
Davis Coal & Coke Co., The	No. 6	10,499	8,988	19,487	343	544	18,600
Davis Coal & Coke Co., The	No. 14 Kittanning	7,303	2,568	9,871	86	44	9,741
Davis Coal & Coke Co., The	No. 19	22,868	23,790	46,658	67	106	46,485
Davis Coal & Coke Co., The	Dean No. 20	7,216	16,100	23,316	.....	.....	23,316
Davis Coal & Coke Co., The	No. 50	15,702	14,150	29,852	1,269	93	28,490
Davis Coal & Coke Co., The	No. 51	27,080	27,297	54,377	558	363	53,456
Dean Coal Co.	Ott No. 20	7,285	16,197	23,482	200	.....	23,282
Deep Run Big Vein Coal Co.	Grant	3,708	12,699	16,407	.....	.....	16,407
Deep Run Big Vein Coal Co.	Lantz	24,471	13,083	37,554	.....	240	37,314
Deep Run Big Vein Coal Co.	Lantz No. 2 (Walreece)	6,125	8,039	14,164	.....	.....	14,164
Emory Run Coal Co.	Emory	1,801	11,521	13,322	.....	.....	13,322
Glade Run Coal & Coke Co.	Florence	3,598	5,945	9,543	.....	.....	9,543
Gleason Coal & Coke Co.	Gleason No. 1	28,268	32,235	60,503	1,200	300	59,003
Hamill Coal & Coke Co.	Smith	12,268	12,472	24,740	.....	.....	24,740
Jaffy Coal Mining Co.	Patton	.....	1,816	1,816	.....	.....	1,816
Mapleville Coal Co.	Mapleville No. 1	.....	1,127	1,127	.....	13	1,114
Masteller Coal Co., The	Hampshire Nos. 2, 3, & 4	22,828	25,380	48,208	235	.....	47,973
Masteller Coal Co., The	New Creek	24,145	31,867	56,012	140	.....	55,872
O. D. Harris & Sons Coal Co.	Harris No. 1	4,027	.....	4,027	4	3	4,020
Piedmont Coal Corporation	Fahey	.....	6,393	6,393	135	.....	6,258
Western Maryland Coal Co.	Kittanning No. 2, Freeport	23,336	25,668	49,004	.....	85	48,919
Totals		311,880	385,362	697,242	5,763	2,066	689,413
GRANT COUNTY							
Buffalo Creek-Cumberland Coal Co.	Buffalo	37,486	.....	37,486	446	.....	37,040
Davis Coal & Coke Co., The	Fairfax No. 60	193	4,277	4,470	.....	4	4,466
Davis Coal & Coke Co., The	Henry No. 22	64,866	75,604	140,470	3,011	216	137,243
Emmons Coal Mining Co.	Culpepper No. 1	37,200	40,300	77,500	1,080	180	76,240
S. H. Jordan	Cottage Street	3,150	4,193	7,343	.....	179	7,164
Totals		142,895	124,374	267,269	4,537	579	262,153

Coal Tonnage Produced in Mineral and Grant Counties by the Various Mines for the Year Ending June 30, 1916.

NAME OF COMPANY	NAME OF MINE	PRODUCTION OF COAL (Tons of 2,240 lbs.)			DISTRIBUTION OF COAL (Tons of 2,240 lbs.)		
		First Six Months.	Second Six Months.	Total Coal Produced During Year.	Used in Operation of Mine.	Furnished Local Trade and Tenants.	Quantity Shipped from Mines.
MINERAL COUNTY							
Abrams Creek Coal & Coke Co.	Oakmont No. 1	23,835	29,103	52,938	1,179	360	51,399
Big Vein Coal Co. of West Virginia	Shaw Four-Foot	12,992	10,975	23,967	227	24	23,716
Carroll-Cross Coal Co.	Cross	26,111	24,178	50,289	.....	.....	50,289
Davis Coal & Coke Co., The	Elk Garden No. 6	12,827	16,223	29,050	196	393	28,461
Davis Coal & Coke Co., The	Kittanning No. 14	32,527	19,147	51,674	303	280	51,091
Davis Coal & Coke Co., The	No. 19 Montgomery Run	37,719	16,984	54,703	227	129	54,347
Davis Coal & Coke Co., The	No. 50 Montgomery Run	20,683	17,097	37,780	988	86	36,706
Davis Coal & Coke Co., The	No. 51 Montgomery Run	33,059	34,949	68,008	635	183	67,190
Davis Coal & Coke Co., The	Ott No. 20	17,574	11,022	28,596	646	.....	27,950
Deep Run Big Vein Coal Co.	Lantz	.....	20,684	20,684	50	.....	20,634
Deep Run Big Vein Coal Co.	Walreece	.....	843	843	.....	.....	843
Glade Run Coal & Coke Co.	Florence	1,509	3,223	4,732	.....	.....	4,732
Gleason Coal & Coke Co.	Gleason	35,782	30,844	66,626	900	300	65,426
Hamill Coal & Coke Co.	Smith	4,160	15,515	19,675	.....	.....	19,675
Masteller Coal Co., The	Hampshire Nos. 1, 2, & 3	29,181	24,175	53,356	255	.....	53,101
Masteller Coal Co., The	New Creek	19,171	23,049	42,220	103	.....	42,117
O. D. Harris & Sons Coal Co.	Harris No. 1	1,261	1,865	3,126	.....	10	3,116
Western Maryland Coal Co.	Freeport No. 6	.....	3,851	3,851	.....	.....	3,851
Western Maryland Coal Co.	Kittanning No. 2	14,320	12,903	27,223	125	.....	27,098
Totals		322,711	316,630	639,341	5,834	1,765	631,742
GRANT COUNTY							
Buffalo Creek-Cumberland Coal Co.	Buffalo Creek No. 1	27,440	20,228	47,668	450	80	47,138
Davis Coal & Coke Co., The	Henry No. 22	64,693	57,762	122,454	3,620	285	118,550
Jordan, S. H.	Cottage Street	3,382	4,915	8,297	212	.....	8,085
Totals		95,515	82,905	178,420	4,282	365	173,773

Coal Tonnage Produced in Mineral and Grant Counties by the Various Mines for the Year Ending June 30, 1915.

NAME OF COMPANY	NAME OF MINE	PRODUCTION OF COAL (Tons of 2,240 lbs.)			DISTRIBUTION OF COAL (Tons of 2,240 lbs.)		
		First Six Months.	Second Six Months.	Total Coal Produced During Year.	Used in Operation of Mine.	Furnished Local Trade and Tenants.	Quantity Shipped from Mines.
MINERAL COUNTY							
Abrams Creek Coal & Coke Co.	Oakmont No. 1	15,774	16,650	32,424	977	325	31,122
Big Vein Coal Co. of West Virginia	Bakerstown	10,647	11,345	21,992	214	.....	21,778
Carroll-Cross Coal Co.	Cross	25,965	13,280	39,245	.....	.....	39,245
Davis Coal & Coke Co., The	No. 6	22,881	20,026	42,907	339	742	41,826
Davis Coal & Coke Co., The	No. 50	100	14,719	14,819	435	6	14,378
Davis Coal & Coke Co., The	No. 51	1,080	30,928	32,008	432	33	31,543
Davis Coal & Coke Co., The	No. 14	43,136	42,654	85,790	350	468	84,972
Davis Coal & Coke Co., The	Montgomery Run No. 19	.....	32,258	32,258	.....	.....	32,258
Davis Coal & Coke Co., The	No. 20	28,808	9,148	37,956	554	.....	37,402
Glade Run Coal & Coke Co.	Florence	6,167	.....	6,167	.....	.....	6,167
Gleason Coal & Coke Co.	Gleason	43,303	50,139	93,442	700	360	92,382
Grafton Mining Co.	Blaine No. 2	14,024	11,124	25,148	139	40	24,969
Harris & Sons Coal Co., O. D.	Harris No. 2	1,247	352	1,599	.....	90	1,509
Masteller Coal Co., The	Hampshire Nos. 1, 2, & 3	33,478	19,866	53,344	225	.....	53,119
Masteller Coal Co., The	New Creek	19,113	18,138	37,251	75	.....	37,176
Totals		265,723	290,627	556,350	4,440	2,064	549,846
GRANT COUNTY							
Buffalo Creek-Cumberland Coal Co.	No. 1	16,437	23,110	39,547	500	120	38,927
Davis Coal & Coke Co., The	Henry No. 22	51,747	68,900	120,647	3,679	415	116,553
Jordan, S. H.	Cottage Street	1,002	3,925	4,927	.....	247	4,680
Totals		69,186	95,935	165,121	4,179	782	160,160

Coal Tonnage Produced in Mineral and Grant Counties by the Various Mines for the Year Ending June 30, 1914.

NAME OF COMPANY	NAME OF MINE	PRODUCTION OF COAL (Tons of 2,240 lbs.)			DISTRIBUTION OF COAL (Tons of 2,240 lbs.)		
		First Six Months.	Second Six Months.	Total Coal Produced During Year.	Used In Operation of Mine.	Furnished Local Trade and Tenants.	Quantity Shipped from Mines.
MINERAL COUNTY							
Abrams Creek Coal & Coke Co.	Oakmont No. 1	51,608	26,614	78,222	1,284	459	76,479
Big Vein Coal Co. of West Virginia	Shaw 4-Ft.	9,465	10,560	20,025	165	30	19,830
Carroll-Cross Coal Co.	Cross	20,100	15,522	35,622	.....	.....	35,622
Carroll-Cross Coal Co.	Imperial	7,779	5,391	13,170	.....	.....	13,170
Davis Coal & Coke Co., The	Elk Garden No. 6	13,497	25,172	38,669	143	796	37,730
Davis Coal & Coke Co., The	Kittanning No. 14	41,371	40,827	82,198	631	426	81,141
Davis Coal & Coke Co., The	Ott No. 20	25,587	22,373	47,960	711	.....	47,249
Davis Coal & Coke Co., The	Montgomery Run No. 19	47,815	27,202	75,017	13	195	74,809
Davis Coal & Coke Co., The	Hampshire No. 50	18,728	10,103	28,831	771	77	27,983
Davis Coal & Coke Co., The	Hampshire No. 51	32,951	21,973	54,924	1,090	114	53,720
Grafton Mining Co.	Western Maryland	11,207	11,350	22,557	250	.....	22,307
Gleason Coal & Coke Co.	Gleason	24,744	24,883	49,627	500	250	48,877
Hamill Coal & Coke Co.	Smith	14,146	8,212	22,358	169	.....	22,189
Masteller Coal Co., The	Hampshire Nos. 1 & 2	27,333	25,337	52,670	226	.....	52,444
Masteller Coal Co., The	New Creek	34,933	31,389	66,322	170	.....	66,152
Totals		381,264	306,908	688,172	6,123	2,347	679,702
GRANT COUNTY							
Buffalo Creek-Cumberland Coal Co.	Buffalo Creek No. 1	50,038	38,174	88,212	800	96	87,316
Davis Coal & Coke Co., The	Henry No. 22	50,349	41,741	92,090	14,303	451	77,336
Jordan, S. H.	Cottage Street	5,438	4,006	9,444	.....	275	9,169
Totals		105,825	83,921	189,746	15,103	822	173,821

Coal Tonnage Produced in Mineral and Grant Counties by the Various Mines for the Year Ending June 30, 1913.

NAME OF COMPANY	NAME OF MINE	PRODUCTION OF COAL (Tons of 2,240 lbs.)			DISTRIBUTION OF COAL (Tons of 2,240 lbs.)		
		First Six Months.	Second Six Months.	Total Coal Produced During Year.	Used in Operation of Mine.	Furnished Local Trade and Tenants.	Quantity Shipped from Mines.
MINERAL COUNTY							
Davis Coal & Coke Co., The	Elk Garden No. 6	20,501	22,240	42,741	92	723	41,926
Davis Coal & Coke Co., The	Kittanning No. 14	39,379	47,024	86,403	789	413	85,201
Davis Coal & Coke Co., The	No. 19	48,991	48,264	97,255	.....	238	97,017
Davis Coal & Coke Co., The	Ott No. 20	22,333	26,820	49,153	716	.....	48,437
Davis Coal & Coke Co., The	Hampshire No. 50	18,233	18,976	37,209	1,181	.....	36,028
Davis Coal & Coke Co., The	Hampshire No. 51	26,902	29,408	56,310	871	31	55,408
Masteller Coal Co.	Hampshire Nos. 1 & 2	29,260	28,331	57,591	185	.....	57,406
Masteller Coal Co.	New Creek	10,360	28,826	39,186	105	.....	39,081
Carroll-Cross Coal Co.	Imperial	5,000	5,000	10,000	200	400	9,400
Carroll-Cross Coal Co.	Black Diamond	13,247	16,857	30,104	.....	650	29,454
Carroll-Cross Coal Co.	Imperial No. 2	.....	2,140	2,140	.....	.....	2,140
Grafton Mining Co.	Western Maryland	11,455	11,898	23,353	.....	.....	23,353
Ajax Coal Co.	Ajax	300	200	500	.....	15	485
Hamill Coal & Coke Co.	Smith	16,341	11,262	27,603	200	.....	27,403
Big Vein Coal Co. of West Virginia, The....	Shaw	8,686	9,422	18,108	.....	.....	18,108
Abrams Creek Coal & Coke Co.	Oakmont No. 1	29,066	50,041	79,107	1,066	396	77,645
Gleason Coal & Coke Co.	Gleason Nos. 1 & 2	19,680	27,107	46,787	900	350	45,537
Totals		319,734	383,816	703,550	6,305	3,216	694,029
GRANT COUNTY							
Davis Coal & Coke Co., The	Henry No. 22	38,918	55,418	94,336	14,629	520	79,187
Buffalo Creek-Cumberland Coal Co.	Buffalo Creek	40,970	41,903	82,873	.....	.....	82,873
S. H. Jordan	Cottage Street	.....	1,169	1,169	.....	.....	1,169
Totals		79,888	98,490	178,378	14,629	520	163,229

Coal Tonnage Produced in Mineral and Grant Counties by the Various Mines for the Year Ending June 30, 1912.

NAME OF COMPANY	NAME OF MINE	PRODUCTION OF COAL (Tons of 2,240 lbs.)			DISTRIBUTION OF COAL (Tons of 2,240 lbs.)		
		First Six Months.	Second Six Months.	Total Coal Produced During Year.	Used in Operation of Mine.	Furnished Local Trade and Tenants.	Quantity Shipped from Mines.
MINERAL COUNTY							
Davis Coal & Coke Co., The	Elk Garden No. 6	15,944	34,132	50,076	30	663	49,383
Davis Coal & Coke Co., The	Wabash No. 9	.....	16,179	16,179	16	89	16,074
Davis Coal & Coke Co., The	Tyson No. 10	12,918	3,389	16,307	53	.....	16,254
Davis Coal & Coke Co., The	Kittanning No. 14	36,134	38,717	74,851	755	388	73,708
Davis Coal & Coke Co., The	Ott No. 20	13,135	18,646	31,781	504	.....	31,277
Davis Coal & Coke Co., The	Montgomery Run No. 19	35,626	49,042	84,668	.....	304	84,364
Davis Coal & Coke Co., The	Hampshire No. 50	13,724	19,094	32,818	972	11	31,835
Davis Coal & Coke Co., The	Hampshire No. 51	42,830	58,249	101,079	612	280	100,187
Abrams Creek Coal & Coke Co.	Oakmont	21,119	23,708	44,827	853	237	43,737
Masteller Coal Co.	Hampshire No. 1	6,783	5,652	12,435	27	.....	12,408
Masteller Coal Co.	Hampshire No. 2	23,185	19,318	42,503	123	.....	42,380
Masteller Coal Co.	Hampshire Six-Foot	1,398	1,112	2,510	.....	.....	2,510
Masteller Coal Co.	New Creek	5,108	20,389	25,497	75	.....	25,422
Hamill Coal & Coke Co.	Smith	4,086	20,333	24,419	148	.....	24,271
Western Maryland Coal Co.	Wabash Nos. 1, 2, 3, & 4	16,902	9,142	26,044	.....	75	25,969
Gleason Coal & Coke Co.	Gleason No. 1	17,942	24,868	42,810	720	360	41,730
Big Vein Coal Mining Co.	Bakerstown	12,560	14,440	27,000	250	150	26,600
Denman Coal Co.	Black Diamond	.....	137	137	.....	.....	137
Totals		279,394	376,547	655,941	5,138	2,557	648,246
GRANT COUNTY							
Davis Coal & Coke Co., The	Henry No. 22	54,033	65,810	119,843	12,037	483	107,323
Buffalo Creek-Cumberland Coal Co.	Buffalo Creek No. 1	34,574	34,490	69,064	1,000	936	67,128
Totals		88,607	100,300	188,907	13,037	1,419	174,451

Coal Tonnage Produced in Mineral and Grant Counties by the Various Mines for the Year Ending June 30, 1911.

NAME OF COMPANY	NAME OF MINE	PRODUCTION OF COAL (Tons of 2,240 lbs.)			DISTRIBUTION OF COAL (Tons of 2,240 lbs.)		
		First Six Months.	Second Six Months.	Total Coal Produced During Year.	Used in Operation of Mine.	Furnished Local Trade and Tenants.	Quantity Shipped from Mines.
MINERAL COUNTY							
Davis Coal & Coke Co., The	Elk Garden No. 6	19,693	13,825	33,518	.....	944	32,574
Davis Coal & Coke Co., The	Wabash No. 9	57,771	43,790	101,561	36	418	101,107
Davis Coal & Coke Co., The	Tyson No. 10	10,158	12,664	22,822	.....	.....	22,822
Davis Coal & Coke Co., The	Kittanning No. 14	24,264	31,087	55,351	49	293	55,009
Davis Coal & Coke Co., The	Kittanning No. 15	982	.....	982	.....	50	932
Davis Coal & Coke Co., The	Montgomery Run No. 19	39,232	33,140	72,372	.....	423	71,949
Davis Coal & Coke Co., The	Ott No. 20	19,922	8,625	28,547	68	.....	28,479
Davis Coal & Coke Co., The	No. 50	13,970	12,650	26,620	663	.....	25,957
Davis Coal & Coke Co., The	No. 51	23,397	18,672	42,069	516	.....	41,553
Glade Run Coal & Coke Co.	Sarah No. 3	1,550	1,500	3,050	10	40	3,000
Hamill Coal & Coke Co.	Smith	18,541	9,025	27,566	200	.....	27,366
Gleason Coal & Coke Co.	Gleason No. 2	15,886	15,488	31,374	65	207	31,102
Western Maryland Coal Co.	W. Md. Nos. 2, 3, & 4	15,161	16,241	31,402	.....	.....	31,402
Abrams Creek Coal & Coke Co.	Oakmont	23,146	18,482	41,628	705	262	40,661
Big Vein Coal Co. of West Virginia	Shaw Four-Foot	11,505	11,402	22,907	250	100	22,557
Denman Coal Co.	Denman No. 3	5,138	3,217	8,355	116	157	8,082
Masteller Coal Co., The	New Creek	14,003	8,177	22,180	62	.....	22,118
Masteller Coal Co., The	Hampshire	21,287	21,468	42,755	132	.....	42,623
Totals		335,606	279,453	615,059	2,872	2,894	609,293
GRANT COUNTY							
Davis Coal & Coke Co., The	Henry No. 22	89,942	63,619	153,561	11,333	382	141,846
Buffalo Creek-Cumberland Coal Co.	Buffalo Creek	30,992	36,884	67,876	300	1,048	66,528
Cottage Street Coal Co.	Cotage Street	25	.....	25	.....	25	.....
Totals		120,959	100,503	221,462	11,633	1,455	208,374

Coal Tonnage Produced in Mineral and Grant Counties by the Various Mines for the Year Ending June 30, 1910.

NAME OF COMPANY	NAME OF MINE	PRODUCTION OF COAL (Tons of 2,240 lbs.)			DISTRIBUTION OF COAL (Tons of 2,240 lbs.)		
		First Six Months.	Second Six Months.	Total Coal Produced During Year.	Used in Operation of Mine.	Furnished Local Trade and Tenants.	Quantity Shipped from Mines.
MINERAL COUNTY							
Glade Run Coal Co., The	Sarah No. 1	3,000	3,000	6,000	72	.....	5,928
Smith Coal Co.	Smith No. 1	19,379	24,684	44,063	275	.....	43,788
Gleason Coal & Coke Co.	Gleason No. 2	13,172	22,388	35,560	800	200	34,560
Western Maryland Coal Co.	Wabash Nos. 2, 3, & 4	13,377	14,885	28,262	.....	100	28,162
Abrams Creek Coal & Coke Co.	Oakmont	24,630	18,315	42,945	831	278	41,836
Big Vein Coal Co.	Four-Foot	6,792	11,939	18,731	127	.....	18,604
Denman Coal Co.	Denman No. 3	3,423	11,012	14,435	210	50	14,175
Masteller Coal Co.	Hampshire	17,963	24,649	42,612	99	.....	42,513
Masteller Coal Co.	New Creek & Hampshire 4-Ft.	3,581	20,614	24,195	65	.....	24,130
Davis Coal & Coke Co., The	Elk Garden No. 6	28,663	22,888	51,551	115	744	50,692
Davis Coal & Coke Co., The	Wabash No. 9	112,324	98,208	210,532	.....	799	209,733
Davis Coal & Coke Co., The	Tyson No. 10	33,053	23,214	56,267	.....	56	56,211
Davis Coal & Coke Co., The	Kittanning No. 14	34,166	37,433	71,599	.....	280	71,319
Davis Coal & Coke Co., The	Kittanning No. 15	3,604	2,084	5,688	.....	123	5,565
Davis Coal & Coke Co., The	Montgomery Run No. 19	44,967	52,426	97,393	.....	459	96,934
Davis Coal & Coke Co., The	Ott No. 20	15,241	20,616	35,857	.....	.....	35,857
Davis Coal & Coke Co., The	Hampshire No. 50	11,890	16,232	28,122	1,117	.....	27,005
Davis Coal & Coke Co., The	Hampshire No. 51	18,721	26,139	44,860	258	.....	44,602
Totals		407,946	450,726	858,672	3,969	3,089	851,614
GRANT COUNTY							
Davis Coal & Coke Co., The	Henry No. 22	58,265	86,300	144,565	12,332	281	131,952
Buffalo Creek-Cumberland Coal Co.	Buffalo Creek	29,189	39,866	69,055	235	150	68,670
Cottage Street Coal Co.	Cottage Street	307	3,572	3,879	50	55	3,774
Totals		87,761	129,738	217,499	12,617	486	204,396

Coal Tonnage Produced in Mineral and Grant Counties by the Various Mines for the Year Ending June 30, 1909.

NAME OF COMPANY	NAME OF MINE	PRODUCTION OF COAL (Tons of 2,240 lbs.)			DISTRIBUTION OF COAL (Tons of 2,240 lbs.)		
		First Six Months.	Second Six Months.	Total Coal Produced During Year.	Used In Operation of Mine.	Furnished Local Trade and Tenants.	Quantity Shipped from Mines.
MINERAL COUNTY							
Davis Coal & Coke Co., The	No. 6	34,687	31,090	65,777	180	920	64,677
Davis Coal & Coke Co., The	No. 9	113,785	100,361	214,146	.....	581	213,565
Davis Coal & Coke Co., The	Tyson No. 10	33,308	29,579	62,887	.....	34	62,853
Davis Coal & Coke Co., The	Kittanning No. 14	32,098	35,229	67,327	.....	247	67,080
Davis Coal & Coke Co., The	Kittanning No. 15	5,027	6,564	11,591	.....	52	11,539
Davis Coal & Coke Co., The	Ott No. 20	18,323	20,491	38,814	.....	.....	38,814
Davis Coal & Coke Co., The	Montgomery Run No. 19	24,703	42,243	66,946	.....	229	66,717
Davis Coal & Coke Co., The	No. 50	8,061	13,593	21,654	787	80	20,787
Davis Coal & Coke Co., The	No. 51	14,024	19,488	33,512	213	83	33,216
Abrams Creek Coal & Coke Co.	Oakmont	10,235	21,092	31,327	482	139	30,706
Piedmont & Potomac Coal Co.	Karr	4,775	664	5,439	.....	.....	5,439
Masteller Coal Co.	Hampshire	14,759	13,723	28,482	.....	55	28,427
Masteller Coal Co.	New Creek	77	1,575	1,652	.....	.....	1,652
Smith Coal Co.	Smith	7,959	18,324	26,283	180	.....	26,103
Western Maryland Coal Co.	Blaine Nos. 2, 3, & 4	5,200	5,201	10,401	.....	25	10,376
Gleason Coal & Coke Co.	Gleason No. 2	22,000	20,000	42,000	500	250	41,250
Big Vein Coal Co. of West Virginia	Four-Foot	2,544	6,355	8,899	38	.....	8,861
Denman Coal Co.	Denman No. 3	794	871	1,665	.....	.....	1,665
Glade Run Coal & Coke Co.	Sarah	3,200	2,150	5,350	69	.....	5,281
Emory Run Coal Co.	Emory Run No. 1	1,506	.....	1,506	.....	.....	1,506
Totals		357,065	388,593	745,658	2,449	2,695	740,514
GRANT COUNTY							
Davis Coal & Coke Co., The	Henry No. 22	90,665	74,330	164,995	11,134	724	153,137
Buffalo Creek-Cumberland Coal Co.	Buffalo Creek	4,624	6,920	11,544	143	.....	11,401
Cottage Street Coal Co.	Cottage Street	758	109	867	20	187	660
Totals		96,047	81,359	177,406	11,297	911	165,198

Coal Tonnage Produced in Mineral and Grant Counties by the Various Mines for the Year Ending June 30, 1908.

NAME OF COMPANY	NAME OF MINE	PRODUCTION OF COAL (Tons of 2,240 lbs.)			DISTRIBUTION OF COAL (Tons of 2,240 lbs.)		
		First Six Months.	Second Six Months.	Total Coal Produced During Year.	Used in Operation of Mine.	Furnished Local Trade and Tenants.	Quantity Shipped from Mines.
MINERAL COUNTY							
Davis Coal & Coke Co., The	No. 6	29,559	35,769	65,328	208	1,319	63,801
Davis Coal & Coke Co., The	Wabash No. 9	85,245	83,802	169,047	15	707	168,325
Davis Coal & Coke Co., The	Tyson No. 10	.....	13,689	13,689	.....	.....	13,689
Davis Coal & Coke Co., The	Kittanning No. 14	20,719	19,898	40,617	.....	106	40,511
Davis Coal & Coke Co., The	Kittanning No. 15	.....	1,766	1,766	.....	.....	1,766
Davis Coal & Coke Co., The	Ott No. 20	26,142	11,757	37,899	.....	.....	37,899
Davis Coal & Coke Co., The	Montgomery Run No. 19	3,408	9,183	12,591	204	244	12,143
Davis Coal & Coke Co., The	No. 50	13,852	8,263	22,115	286	103	21,726
Davis Coal & Coke Co., The	No. 51	16,867	12,054	28,921	224	105	28,592
Abrams Creek Coal & Coke Co.	Oakmont	18,298	16,372	34,670	540	300	33,830
Piedmont Brick & Coal Co.	Karr	255	4,316	4,571	.....	.....	4,571
Piedmont & Potomac Coal Co.	Virginia	10,000	10,000	*20,000	.....	.....	20,000
Masteller Coal Co.	Hampshire	17,436	12,413	29,849	.....	255	29,594
Masteller Coal Co.	New Creek	24,127	4,372	28,499	125	.....	28,374
Smith Coal Co.	Smith	27,766	17,085	44,851	189	.....	44,662
Gleason Coal & Coke Co.	Gleason No. 2	17,904	12,003	29,907	.....	.....	29,907
Big Vein Coal Co. of West Virginia, The	Shaw	17,259	5,516	22,775	127	122	22,526
Denman Coal Co.	Denman No. 3	5,230	1,624	6,854	.....	.....	6,854
Glade Run Coal & Coke Co.	Sarah	6,950	1,396	8,346	35	60	8,251
Totals		341,017	281,278	622,295	1,953	3,321	617,021
GRANT COUNTY							
Davis Coal & Coke Co., The	Henry No. 22	94,854	93,407	188,261	12,337	930	174,994
Buffalo Creek-Cumberland Coal Co.	Buffalo Creek	49,606	2,905	52,511	416	.....	52,095
Cottage Street Coal Co.	Cottage Street	.....	1,670	1,670	33	241	1,396
Totals		144,460	97,982	242,442	12,786	1,171	228,485

* Estimated.

Coal Tonnage Produced in Mineral and Grant Counties by the Various Mines for the Year Ending June 30, 1907.

NAME OF COMPANY	NAME OF MINE	PRODUCTION OF COAL (Tons of 2,240 lbs.)			DISTRIBUTION OF COAL (Tons of 2,240 lbs.)		
		First Six Months.	Second Six Months.	Total Coal Produced During Year.	Used in Operation of Mine.	Furnished Local Trade and Tenants.	Quantity Shipped from Mines.
MINERAL COUNTY							
Davis Coal & Coke Co., The	No. 14	3,019	13,595	16,614	.....	11	16,603
Davis Coal & Coke Co., The	No. 20	30,647	27,100	57,747	.....	.....	57,747
Davis Coal & Coke Co., The	No. 9	89,199	90,979	180,178	12	1,354	178,812
Davis Coal & Coke Co., The	No. 6	23,820	23,385	47,205	18	1,912	45,275
Davis Coal & Coke Co., The	No. 19	11,621	14,800	26,421	491	321	25,609
Davis Coal & Coke Co., The	No. 50	.....	7 221	7,221	.....	7	7,214
Davis Coal & Coke Co., The	No. 51	17,177	8,370	25,547	.....	109	25,438
Smith Coal Co.	Smith	22,151	26,837	48,988	300	.....	48,688
Piedmont & Potomac Coal Co.	Virginia	12,481	10,029	22,510	.....	.....	22,510
Big Vein Coal Co. of West Virginia, The	Big Vein	19,699	15,388	35,087	138	159	34,790
Taylor Coal Co.	Taylor	4,800	4,000	8,800	.....	.....	8 800
Masteller Coal Co.	Hampshire	16,690	15,610	32,300	240	.....	32,060
Masteller Coal Co.	New Creek	2,706	13,538	16,244	.....	.....	16,244
Abrams Creek Coal & Coke Co.	Oakmont	14,085	19,124	33,209	100	.....	33,109
Gleason Coal & Coke Co.	Gleason	20,000	20,000	40,000	.....	100	39.900
Glade Run Coal & Coke Co.	Sarah	3,788	5,313	9,101	60	60	8,981
Totals		291,883	315,289	607,172	1,359	4,033	601,780
GRANT COUNTY							
Davis Coal & Coke Co., The	No. 22	95,476	96,769	192,245	10,382	710	181.153
Buffalo Creek-Cumberland Coal Co.	Buffalo Creek	35,003	44,294	79,297	900	.....	78.397
Totals		130,479	141,063	271,542	11,282	710	259,550

Photo by E. E. HARRIS.

PLATE XXV.—West quarry of Standard Lime and Stone Company at Keyser. Wooded ground at right is Oriskany followed toward left by Helderberg Limestone and upper part of Bossardville Limestone. See Limestone Run Section and Plate XXVI.

Coal Tonnage Produced in Mineral and Grant Counties by the Various Mines for the Year Ending June 30, 1906.

NAME OF COMPANY	NAME OF MINE	PRODUCTION OF COAL (Tons of 2,240 lbs.)			DISTRIBUTION OF COAL (Tons of 2,240 lbs.)		
		First Six Months.	Second Six Months.	Total Coal Produced During Year.	Used in Operation of Mine.	Furnished Local Trade and Tenants.	Quantity Shipped from Mines.
MINERAL COUNTY							
Davis Coal & Coke Co., The	No. 19	614	11,987	12,601	365	240	11,996
Davis Coal & Coke Co., The	No. 20	22,199	28,989	51,188	.....	.....	51,188
Davis Coal & Coke Co., The	No. 9	108,695	100,170	208,865	.....	553	208,312
Davis Coal & Coke Co., The	No. 6	53,165	39,336	92,501	37	1,754	90,710
Davis Coal & Coke Co., The	No. 50	956	2,875	3,831	.....	50	3,781
Davis Coal & Coke Co., The	No. 51	.....	5,382	5,382	.....	40	5,342
Smith Coal Co.	Smith	13,991	26,127	40,118	.....	.....	40,118
Stafford Coal Mining Co.	Virginia	13,000	12,000	25,000	100	50	24,850
Big Vein Coal Co. of West Virginia	Big Vein	7,711	17,284	24,995	85	86	24,824
Big Vein Coal Co. of West Virginia	Four-Foot	894	286	1,180	.....	.....	1,180
Taylor Coal Co.	Taylor	6,400	3,000	9,400	.....	.....	9,400
Masteller Coal Co.	Hampshire	1,905	21,877	23,782	135	.....	23,647
Abrams Creek Coal & Coke Co.	Oakmont	10,871	14,651	25,522	.....	38	25,484
Gleason Coal & Coke Co.	Gleason No. 2	.....	5,782	5,782	.....	.....	5,782
Piedmont Brick & Coal Co.	Piedmont	3,000	7,000	10,000	.....	.....	10,000
Totals		243,401	296,746	540,147	722	2,811	536,614
GRANT COUNTY							
Davis Coal & Coke Co., The	No. 22	67,431	94,465	161,896	8,540	546	152,810
Davis Coal & Coke Co., The	No. 33	1,835	1,004	2,839	1,245	.....	1,594
Buffalo Creek-Cumberland Coal Co.	Buffalo Creek	24,973	39,129	64,102	510	60	63,532
Totals		94,239	134,598	228,837	10,295	606	217,936

Coal Tonnage Produced in Mineral and Grant Counties by the Various Mines for the Year Ending June 30, 1905.

NAME OF COMPANY	NAME OF MINE	PRODUCTION OF COAL (Tons of 2,240 lbs.)			DISTRIBUTION OF COAL (Tons of 2,240 lbs.)		
		First Six Months.	Second Six Months.	Total Coal Produced During Year.	Used in Operation of Mine.	Furnished Local Trade and Tenants.	Quantity Shipped from Mines.
MINERAL COUNTY							
Davis Coal & Coke Co., The	No. 18	1,472	.....	1,472	.....	65	1,407
Davis Coal & Coke Co., The	No. 8	8,304	.....	8,304	.....	20	8,284
Davis Coal & Coke Co., The	No. 20	17,073	18,298	35,371	.....	.....	35,371
Davis Coal & Coke Co., The	No. 9	85,289	86,598	171,887	.....	363	171,524
Davis Coal & Coke Co., The	No. 6	94,814	67,788	162,602	84	1,816	160,702
Smith Coal Co.	Smith	12,943	12,043	24,986	184	.....	24,802
Stafford Coal Mining Co.	Virginia	2,169	15,591	17,760	30	.....	17,730
Big Vein Coal Co. of West Virginia	Big Vein & Four-Foot	5,867	11,638	17,505	39	142	17,324
Taylor Coal Co.	Taylor	2,750	2,750	5,500	.....	.....	5,500
Masteller Coal Co., The	Hampshire	17,581	19,513	37,094	315	.....	36,779
Abrams Creek Coal & Coke Co.	Oakmont	9,407	11,783	21,190	.....	100	21,090
Gleason Coal & Coke Co.	Gleason	.....	1,500	1,500	.....	.....	1,500
Totals		257,669	247,502	505,171	652	2,506	502,013
GRANT COUNTY							
Davis Coal & Coke Co., The	No. 22	60,077	71,384	131,461	9,191	443	121,827
Davis Coal & Coke Co., The	No. 33	.....	885	885	172	.....	713
Buffalo Creek-Cumberland Coal Co.	Buffalo Creek No. 1	17,571	17,136	34,707	312	6	34,389
Totals		77,648	89,405	167,053	9,675	449	156,929

Coal Tonnage Produced in Mineral and Grant Counties by the Various Mines for the Year Ending June 30, 1904.

NAME OF COMPANY	NAME OF MINE	PRODUCTION OF COAL (Tons of 2,240 lbs.)			DISTRIBUTION OF COAL (Tons of 2,240 lbs.)		
		First Six Months.	Second Six Months.	Total Coal Produced During Year.	Used in Operation of Mine.	Furnished Local Trade and Tenants.	Quantity Shipped from Mines.
MINERAL COUNTY							
Davis Coal & Coke Co., The	No. 18	22,363	12,874	35,237	.....	97	35,140
Davis Coal & Coke Co., The	No. 8	20,939	17,547	38,486	.....	194	38,292
Davis Coal & Coke Co., The	No. 20	6,662	15,688	22,350	.....	22	22,328
Davis Coal & Coke Co., The	No. 9	38,127	50,946	89,073	.....	311	88,762
Davis Coal & Coke Co., The	No. 6	76,394	82,775	159,169	100	1,712	157,357
Smith Coal Co.	Smith	6,244	13,563	19,807	200	.....	19,607
Piedmont & Potomac Coal Co.	Virginia	18,000	17,500	35,500	.....	150	35,350
Big Vein Coal Co.	Big Vein	10,449	9,800	20,249	57	111	20,081
Taylor Coal Co.	Taylor	1,514	2,161	3,675	.....	.....	3,675
Masteller Coal Co.	Hampshire	15,629	17,594	33,223	245	.....	32,978
Abrams Creek Coal & Coke Co.	Oakdale	2,000	3,000	5,000	.....	.....	5,000
Wabash & Potomac Coal Co.	Blaine	3,281	2,563	5,844	.....	150	5,694
Totals		221,602	246,011	467,613	602	2,747	464,264
GRANT COUNTY							
Davis Coal & Coke Co., The	Shaft No. 22	22,004	36,014	58,018	9,000	375	48,643
Davis Coal & Coke Co., The	Shaft No. 33	10,000	30,076	40,076	.....	.....	40,076
Marion Coal & Coke Co.	Marion	1,500	.....	1,500	.....	.....	1,500
Buffalo Creek-Cumberland Coal Co.	Buffalo No. 1	951	13,424	14,375	75	64	14,236
Totals		34,455	79,514	113,969	9,075	439	104,455

Coal Tonnage Produced in Mineral and Grant Counties by the Various Mines for the Year Ending June 30, 1903.

NAME OF COMPANY	NAME OF MINE	PRODUCTION OF COAL (Tons of 2,240 lbs.)			DISTRIBUTION OF COAL (Tons of 2,240 lbs.)		
		First Six Months.	Second Six Months.	Total Coal Produced During Year.	Used in Operation of Mine.	Furnished Local Trade and Tenants.	Quantity Shipped from Mines.
MINERAL COUNTY							
Davis Coal & Coke Co., The	No. 19	558	.....	558	98	7	453
Davis Coal & Coke Co., The	No. 18	29,617	33,100	62,717	.....	53	62,664
Davis Coal & Coke Co., The	No. 8	31,511	18,207	49,718	.....	101	49,617
Davis Coal & Coke Co., The	No. 20	663	6,077	6,740	.....	.....	6,740
Davis Coal & Coke Co., The	No. 9	.....	11,547	11,547	.....	15	11,532
Davis Coal & Coke Co., The	No. 6	126,492	156,346	282,838	155	1,905	280,778
Smith Coal Co.	Smith	21,973	12,770	34,743	.....	.....	34,743
Piedmont & Potomac Coal Co.	Virginia	15,000	15,000	30,000	.....	200	29,800
Big Vein Coal Co.	Big Vein	10,540	13,826	24,366	.....	.....	24,366
Taylor Coal Co.	Taylor	2,400	2,400	4,800	5	43	4,752
Masteller Coal Co.	Hampshire 4-Ft.	.....	6,555	6,555	.....	.....	6,555
Totals		238,754	275,828	514,582	258	2,324	512,000
GRANT COUNTY							
Davis Coal & Coke Co., The	No. 22 Shaft	6,764	8,404	15,168	7,400	180	7,588
Davis Coal & Coke Co., The	No. 33 Shaft	2,891	9,230	12,121	1,600	.....	10,521
Marion Coal & Coke Co.	Marion	.....	1,200	1,200	.....	50	1,150
Totals		9,655	18,834	28,489	9,000	230	19,259

Coal Tonnage Produced in Mineral County by the Various Mines for the Year Ending June 30, 1902.

NAME OF COMPANY	NAME OF MINE	PRODUCTION OF COAL (Tons of 2,240 lbs.)			DISTRIBUTION OF COAL (Tons of 2,240 lbs.)		
		First Six Months.	Second Six Months.	Total Coal Produced During Year.	Used in Operation of Mine.	Furnished Local Trade and Tenants.	Quantity Shipped from Mines.
Davis Coal & Coke Co., The	Montgomery Run	17,408	9,819	27,227	553	71	26,603
Davis Coal & Coke Co., The	Hampshire 6-Ft.	21,832	27,922	49,754	26	.....	49,728
Davis Coal & Coke Co., The	Windom Big Vein	48,833	31,167	80,000	.....	135	79,865
Davis Coal & Coke Co., The	Windom Gas	859	.....	859	.....	.....	859
Davis Coal & Coke Co., The	Elk Garden No. 6	175,044	150,229	325,273	176	2,068	323,029
Smith Coal Co.	Smith	6,000	8,000	14,000	.....	.....	14,000
Piedmont & Potomac Coal Co.	Virginia	13,500	18,750	32,250	.....	428	31,822
Big Vein Coal Co.	Big Vein & 4-Ft.	8,408	14,410	22,818	.....	811	22,007
Totals		291,884	260,297	552,181	755	3,513	547,913

NOTE:—Henry Shaft of the Davis Coal and Coke Company in Grant County being opened in 1902. Work started in 1901.

Coal Tonnage Produced in Mineral County by the Various Mines for the Year Ending June 30, 1901.

NAME OF COMPANY	NAME OF MINE	PRODUCTION OF COAL (Tons of 2,240 lbs.)			DISTRIBUTION OF COAL (Tons of 2,240 lbs.)		
		First Six Months.	Second Six Months.	Total Coal Produced During Year.	Used in Operation of Mine.	Furnished Local Trade and Tenants.	Quantity Shipped from Mines.
Davis Coal & Coke Co., The	Windom 4-Ft.	27,044	23,437	50,481	.....	.....	50,481
Davis Coal & Coke Co., The	Montgomery Run	92	5.021	5,113	.....	.....	5,113
Davis Coal & Coke Co., The	Hampshire	40,668	25,797	66,465	.....	.....	66,465
Davis Coal & Coke Co., The	Savage	19,481	20,906	40,387	.....	.....	40,387
Davis Coal & Coke Co., The	Windom Big Vein	18,029	15,625	33,654	.....	.....	33,654
W. Va. C. & P. Ry. Co.	Elk Garden No. 6	164,066	151,651	315,717	194	1,658	313,865
Smith Coal Co.	.....	.....	1,955	1,955	.....	.....	1,955
Totals	.....	269,380	244,392	513,772	194	1,658	511,920

Coal Tonnage Produced in Mineral County by the Various Mines for the Year Ending June 30, 1900.

NAME OF COMPANY	NAME OF MINE	PRODUCTION OF COAL (Tons of 2,240 lbs.)			DISTRIBUTION OF COAL (Tons of 2,240 lbs.)		
		First Six Months.	Second Six Months.	Total Coal Produced During Year.	Used in Operation of Mine.	Furnished Local Trade and Tenants.	Quantity Shipped from Mines.
Davis Coal & Coke Co., The	Hampshire	32,112	43,528	75,640	170	10	75,460
Davis Coal & Coke Co., The	Savage	36,183	37,644	73,827	160	.....	73,667
Davis Coal & Coke Co., The	Windom	46,342	45,895	92,237	.....	56	92,181
W. Va. C. & Pgh. Ry. Co.	.....	141,915	179,048	320,963	206	1,857	318,900
Totals	.....	256,552	306,115	562,667	536	1,923	560,208

Coal Tonnage Produced in Mineral County by the Various Mines for the Year Ending June 30, 1899.

NAME OF COMPANY	NAME OF MINE	PRODUCTION OF COAL (Tons of 2,240 lbs.)			DISTRIBUTION OF COAL (Tons of 2,240 lbs.)		
		First Six Months.	Second Six Months.	Total Coal Produced During Year.	Used in Operation of Mine.	Furnished Local Trade and Tenants.	Quantity Shipped from Mines.
Davis Coal & Coke Co., The	Hampshire 6-Ft.	31,413	33,147	64,560	.....	300	64,260
Davis Coal & Coke Co., The	Hampshire 4-Ft.	29,028	38,328	67,356	.....	400	66,956
Davis Coal & Coke Co., The	Windom Gas	28,861	26,975	55,836	.....	400	55,436
Davis Coal & Coke Co., The	Windom Big Vein	12,369	11,561	23,930	.....	.....	23,930
W. Va. Central & Pgh. Ry. Co.	Elk Garden	170,470	172,134	342,604	237	4,419	337,948
Totals	.....	272,141	282,145	554,286	237	5,519	548,530

Coal Tonnage Produced in Mineral County by the Various Mines for the Year Ending June 30, 1898.

NAME OF COMPANY	NAME OF MINE	PRODUCTION OF COAL (Tons of 2,240 lbs.)			DISTRIBUTION OF COAL (Tons of 2,240 lbs.)		
		First Six Months.	Second Six Months.	Total Coal Produced During Year.	Used in Operation of Mine.	Furnished Local Trade and Tenants.	Quantity Shipped from Mines.
(Davis Coal & Coke Co., The)	Windom Big Vein & Windom Gas	39,998	39,357	79,355	.....	28	79,327
(Davis Coal & Coke Co., The)	Windom 4-Foot & Klondike	17,724	26,523	44,247	.....	1	44,246
(Davis Coal & Coke Co., The)	Hampshire	30,672	28,695	59,367	.....	43	59,324
(W. Va. Central & Pgh. Ry. Co.)	Elk Garden Nos. 6 & 7	181,227	146,561	327,788	206	2,135	325,447
Totals		269,621	241,136	510,757	206	2,207	508,344

Coal Tonnage Produced in Mineral County by the Various Mines for the Year Ending June 30, 1897.

NAME OF COMPANY	NAME OF MINE	PRODUCTION OF COAL (Tons of 2,240 lbs.)		
		First Six Months.	Second Six Months.	Total Coal Produced During Year.
(Davis Coal & Coke Co., The)	Windom	25,314	41,102	66,416
(Davis Coal & Coke Co., The)	Hampshire	33,984	29,093	63,077
(Davis Coal & Coke Co., The)	Warnock	9,066	3,970	13,036
(W. Va. Central & Pgh. Ry. Co.)	Elk Garden No. 6	193,840	170,800	364,640
(W. Va. Central & Pgh. Ry. Co.)	Elk Garden No. 7	20,000	10,000	30,000
Totals		282,204	254,965	537,169

RECORDS OF COAL TEST BORINGS.

In Mineral County 10 tests for coal have been bored, and also 4 holes to test the character of some of the Potomac limestones have been made. In Grant County there have been 44 coal test borings. All of these have been located on Maps II and IV and most of their surface levels have been secured. Besides these there are 60 others indicated on the maps, 2 of which have been bored in Preston County and 23 in Tucker County, West Virginia, and 35 in Garrett County, Maryland, all of which have some interest or bearing on the coal resources of Mineral and Grant Counties. Of the 114 coal borings the records of a large proportion were secured from the companies or financial interests which made them and have been used both in the preparation of the structure contour map on the Upper Freeport Coal and in making estimates of the thickness and tonnage of the various commercial coals. In some cases permission to publish the records has been granted by the companies and in others it has not, for reasons that are doubtless considered good. The following tables, therefore, give in summarized form the property, surface elevations, and condensed records of these tests as far as the actual data, including authority for publication, could be secured. The first column gives the key number on Map II or Map IV, as the case may be, by which the position of the borings may be found, and in the elevation column the letter "L" signifies a spirit- or hand-level determination, and "B" indicates that the aneroid was used, checked on the nearest Government elevation. The following abbreviations of company names have been used:

Althouse .....W. D. Althouse and Company.
Brady C. C. .....Brady Coal Corporation.
Bridges Hrs. .....Robert Bridges Heirs.
C. P. C. .....Cumberland Portland Cement Company.
Davis C. & C. .....Davis Coal and Coke Company.
Dodson B. C. .....Dodson Bituminous Coal Corporation.
Herr & Co. .....Herr and Company.
W. Va. P. & P. .....West Virginia Pulp and Paper Company.

Summarized Record of Tests for Coal in Mineral County.

No. on Map II.	NAME OF PROPERTY.	Magisterial District.	Company.	Elevation above Tide.	Elk Lick ("Barton," "Four-foot") Coal.		Bakerstown ("Thomas") Coal.		Mahoning ("Six-foot") Coal.		Up. Freeport ("Davis," "Split-six") Coal.		Lower Kittanning Coal.		Total Depth.	No. on Map II.
					Depth. Top.	Thickness. Feet.	Depth. Top.	Thickness. Feet.	Depth. Top.	Thickness. Feet.	Depth. Top.	Thickness. Feet.	Depth. Top.	Thickness. Feet.		
1	Cumberland Portland Cement Co. No. 1	Frankfort	C. P. C.	1315B												1
2	Cumberland Portland Cement Co. No. 2	Frankfort	C. P. C.	1330B												2
3	Cumberland Portland Cement Co. No. 3	Frankfort	C. P. C.	1345B												3
4	Cumberland Portland Cement Co. No. 4	Frankfort	C. P. C.	1360B												4
5	Davis Coal & Coke Co.	Garrett Co., Md.	Davis C. & C.	1629L												5
6	Eva Duckworth No. 1	Garrett Co., Md.	W. Va. P. & P.	1640L												6
7	Eva Duckworth No. 2	Garrett Co., Md.	W. Va. P. & P.	1675L												7
8	Davis Coal & Coke Co. No. 4	Elk	Davis C. & C.	1545B												8
9	Davis Coal & Coke Co. No. 125	Elk	Davis C. & C.	1630B												9
10	Davis Coal & Coke Co. No. 124	Elk	Davis C. & C.	1700B								0				10
11	Davis Coal & Coke Co. No. 123	Elk	Davis C. & C.	1750B												11
12	Brady Coal Corporation No. 5	Elk	Brady C. C.	1963L												12
13	Mack Inskip No. 1	Elk	Brady C. C.	2047L												13
14	F. O. Idleman No. 4	Elk	Brady C. C.	2179L												14
15	F. O. Idleman No. 2	Elk	Brady C. C.	2239L												15
16	Davis Coal & Coke Co. No. 115	Elk	Davis C. & C.	2120B												16
17	F. O. Idleman No. 3	Elk	Brady C. C.	2466L												17

Summarized Record of Tests for Coal in Grant County.

No. on Map IV.	NAME OF PROPERTY.	Magisterial District.	Company.	Elevation above Tide.	Elk Lick ("Barton," "Four-foot") Coal.		Bakerstown ("Thomas") Coal.		Mahoning ("Six-foot") Coal.		Up. Freeport ("Davis," "Split-six") Coal.		Lower Kittanning Coal.		Total Depth.	No. on Map IV.
					Depth. Top.	Thickness. Feet.	Depth. Top.	Thickness. Feet.	Depth. Top.	Thickness. Feet.	Depth. Top.	Thickness. Feet.	Depth. Top.	Thickness. Feet.		
18	Davis Coal & Coke Co. No. 114	Union	Davis C. & C.	2373L	.....	....	77.8	3.4	.....	....	257.7	3.8	.....	....	263	18
19	Davis Coal & Coke Co. No. 113	Union	Davis C. & C.	2325B	.....	....	142.8	3.9	.....	0	340.2	2.5	.....	....	351.2	19
20	Davis Coal & Coke Co. No. 112	Union	Davis C. & C.	2950B	.....	....	.....	....	.....	....	.....	.....	.....	....	.....	20
21	Herr & Co. No. 1	Union	Herr & Co.	2990B	.....	....	.....	....	.....	....	.....	.....	.....	....	.....	21
22	Davis Coal & Coke Co. No. 110	Union	Davis C. & C.	3330B	.....	....	.....	....	.....	....	.....	.....	.....	....	.....	22
23	Davis Coal & Coke Co. No. 111	Union	Davis C. & C.	3355B	.....	....	.....	....	.....	....	.....	.....	.....	....	.....	23
24	Davis Coal & Coke Co. No. 107	Union	Davis C. & C.	3310B	.....	....	.....	....	.....	....	.....	.....	.....	....	.....	24
25	Davis Coal & Coke Co. No. 108	Union	Davis C. & C.	3380B	.....	....	.....	....	.....	....	.....	.....	.....	....	.....	25
26	Davis Coal & Coke Co. No. 106	Union	Davis C. & C.	3440B	.....	....	.....	....	.....	....	.....	.....	.....	....	.....	26
27	Davis Coal & Coke Co. No. 109	Union	Davis C. & C.	3520B	.....	....	.....	....	.....	....	.....	.....	.....	....	.....	27
28	Davis Coal & Coke Co.	Union	Davis C. & C.	3430B	.....	....	.....	....	.....	....	.....	.....	.....	....	.....	28
29	Davis Coal & Coke Co. No. 2	Union	Davis C. & C.	.....	.....	....	.....	....	.....	....	.....	.....	.....	....	.....	29
30	Davis Coal & Coke Co. No. 1	Union	Davis C. & C.	.....	.....	....	.....	....	.....	....	.....	.....	.....	....	.....	30
31	Davis Coal & Coke Co. No. 104	Union	Davis C. & C.	3615B	.....	....	.....	....	.....	....	.....	.....	.....	....	.....	31
32	Davis Coal & Coke Co. No. 105	Union	Davis C. & C.	3795B	.....	....	.....	....	.....	....	.....	.....	.....	....	.....	32
33	Robert Bridges Hrs. No. 1	Dry Fork (Tucker Co.)	Bridges Hrs.	3680B	.....	....	.....	....	.....	0	127.3	1.4	.....	....	211	33
34	Robert Bridges Hrs. No. 2	Dry Fork (Tucker Co.)	Bridges Hrs.	3715B	.....	....	.....	....	.....	0	79.1	8.2	.....	....	190	34
35	Robert Bridges Hrs. No. 3	Dry Fork (Tucker Co.)	Bridges Hrs.	3665B	.....	....	.....	....	32.9	0.1	42.1	1.9	.....	....	149	35
36	Robert Bridges Hrs. No. 4	Dry Fork (Tucker Co.)	Bridges Hrs.	3805B	.....	....	.....	....	81.3	1.8	.....	.....	.....	....	84	36
37	W. D. Althouse & Co. No. 1	Garrett Co., Md.	Althouse	2365B	.....	....	.....	....	.....	....	.....	.....	.....	....	.....	37
38	W. D. Althouse & Co. No. 2	Garrett Co., Md.	Althouse	2400B	.....	....	.....	....	.....	....	.....	.....	.....	....	.....	38
38A	C. E. Hilleary No. 1	Garrett Co., Md.	R. A. Smith et al.	2580B	.....	....	322	3.6	.....	....	522?	0?	.....	....	.....	38A
38B	J. W. King No. 1	Garrett Co., Md.	Wilt et al.	2590B	.....	....	.....	....	.....	....	.....	.....	.....	....	.....	38B
39	Davis Coal & Coke Co. No. 98	Union	Davis C. & C.	2647L	.....	....	.....	....	.....	....	.....	.....	.....	....	.....	39
40	Davis Coal & Coke Co. No. 99	Union	Davis C. & C.	2715B	.....	....	.....	....	.....	....	.....	.....	.....	....	.....	40
41	Davis Coal & Coke Co. No. 97	Union	Davis C. & C.	2942L	.....	....	.....	....	.....	....	.....	.....	.....	....	.....	41
42	Davis Coal & Coke Co. No. 129	Union	Davis C. & C.	2760B	.....	....	.....	....	.....	....	.....	.....	.....	....	.....	42
43	Davis Coal & Coke Co. No. 101	Union	Davis C. & C.	3028L	.....	....	.....	....	.....	....	.....	.....	.....	....	.....	43
44	Davis Coal & Coke Co.	Union	Davis C. & C.	2435B	.....	....	.....	....	.....	....	.....	.....	.....	....	.....	44
45	Davis Coal & Coke Co. No. 126	Union	Davis C. & C.	2455B	.....	....	.....	....	.....	....	.....	.....	.....	....	.....	45
46	Davis Coal & Coke Co. No. 94	Union	Davis C. & C.	2475L	.....	....	.....	....	.....	....	.....	.....	.....	....	.....	46
47	Davis Coal & Coke Co. No. 96	Union	Davis C. & C.	2515L	.....	....	.....	....	.....	....	.....	.....	.....	....	.....	47
48	Davis Coal & Coke Co. No. 128	Union	Davis C. & C.	2690B	.....	....	.....	....	.....	....	.....	.....	.....	....	.....	48
49	Davis Coal & Coke Co. No. 95	Union	Davis C. & C.	.....	.....	....	.....	....	.....	....	.....	.....	.....	....	.....	49

Summarized Record of Tests for Coal in Grant County (Continued).

No. on Map IV.	NAME OF PROPERTY.	Magisterial District.	Company.	Elevation above Tide.	Elk Lick ("Barton," "Four-foot") Coal.		Bakerstown ("Thomas") Coal.		Mahoning ("Six-foot") Coal.		Up. Freeport ("Davis," "Split-six") Coal.		Lower Kittanning Coal.		Total Depth.	No. on Map IV.
					Depth. Top.	Thickness. Feet.	Depth. Top.	Thickness. Feet.	Depth. Top.	Thickness. Feet.	Depth. Top.	Thickness. Feet.	Depth. Top.	Thickness. Feet.		
50	Davis Coal & Coke Co. No. 127	Union	Davis C. & C.	2935B	.....	....	.....	....	.....	....	.....	.....	.....	....	.....	50
51	Davis Coal & Coke Co. No. 100	Union	Davis C. & C.	2994L	.....	....	.....	....	.....	....	.....	.....	.....	....	.....	51
52	Davis Coal & Coke Co. No. 93	Garrett Co., Md.	Davis C. & C.	2458L	.....	....	.....	....	.....	....	.....	.....	.....	....	.....	52
53	Davis Coal & Coke Co. No. 92	Garrett Co., Md.	Davis C. & C.	.....	.....	....	.....	....	.....	....	.....	.....	.....	....	.....	53
54	Davis Coal & Coke Co. No. 89	Garrett Co., Md.	Davis C. & C.	2589L	.....	....	.....	....	.....	....	.....	.....	.....	....	.....	54
55	Davis Coal & Coke Co. No. 90	Garrett Co., Md.	Davis C. & C.	2828L	.....	....	.....	....	.....	....	.....	.....	.....	....	.....	55
56	Davis Coal & Coke Co. No. 82	Garrett Co., Md.	Davis C. & C.	2622L	.....	....	.....	....	.....	....	.....	.....	.....	....	.....	56
57	Davis Coal & Coke Co. No. 84	Garrett Co., Md.	Davis C. & C.	2685L	263	1.3	.....	0	.....	0	693.4	9	.....	....	703.8	57
58	Davis Coal & Coke Co. No. 88	Garrett Co., Md.	Davis C. & C.	2490B	.....	....	173.7	3.3	.....	0	381.4	8.2	.....	....	391.8	58
59	Davis Coal & Coke Co. No. 87	Garrett Co., Md.	Davis C. & C.	2490B	.....	....	.....	....	.....	....	.....	.....	.....	....	.....	59
60	Davis Coal & Coke Co. No. 86	Garrett Co., Md.	Davis C. & C.	.....	.....	....	.....	....	.....	....	.....	.....	.....	....	.....	60
61	Davis Coal & Coke Co. No. 85	Garrett Co., Md.	Davis C. & C.	.....	.....	....	.....	....	.....	....	.....	.....	.....	....	.....	61
62	Davis Coal & Coke Co. No. E7	Garrett Co., Md.	Davis C. & C.	.....	.....	....	.....	....	.....	....	.....	.....	.....	....	.....	62
63	Davis Coal & Coke Co. No. 83	Garrett Co., Md.	Davis C. & C.	2632L	75	0.3	.....	0	.....	0	486.2	8.3	.....	....	497	63
64	Otis Kitzmiller No. 1	Garrett Co., Md.	Dodson B. C.	2505B	.....	....	.....	....	.....	....	.....	.....	.....	....	.....	64
65	Davis Coal & Coke Co. No. 103	Garrett Co., Md.	Davis C. & C.	2580L	47	1.7	269	4.3	.....	0	454	8	.....	....	464	65
66	Davis Coal & Coke Co. No. 80	Garrett Co., Md.	Davis C. & C.	.....	.....	....	.....	....	.....	....	.....	.....	.....	....	.....	66
67	Davis Coal & Coke Co. No. 78	Garrett Co., Md.	Davis C. & C.	.....	.....	....	.....	....	.....	....	.....	.....	.....	....	.....	67
68	Davis Coal & Coke Co. No. 79	Garrett Co., Md.	Davis C. & C.	2717L	131.5	0.5	.....	0	.....	0	580.4	9.9	.....	....	593	68
69	Davis Coal & Coke Co. No. 68	Garrett Co., Md.	Davis C. & C.	2637L	.....	....	.....	0	.....	0	432.5	9.2	.....	....	442	69
70	Davis Coal & Coke Co. No. 58	Garrett Co., Md.	Davis C. & C.	2656L	.....	....	.....	0	.....	0	289.6	10.2	.....	....	312	70
71	Davis Coal & Coke Co. No. 57	Garrett Co., Md.	Davis C. & C.	2730L	.....	....	.....	0	.....	0	325	8.5	.....	....	343.5	71
72	Davis Coal & Coke Co. No. 46	Garrett Co., Md.	Davis C. & C.	2947L	.....	0	.....	0	.....	0	591.8	8.9	.....	....	607.6	72
73	Davis Coal & Coke Co. No. 81	Garrett Co., Md.	Davis C. & C.	2644L	39	1	256	5.5	.....	0	451.5	7.8	.....	....	461.5	73
74	Davis Coal & Coke Co. No. 73	Union	Davis C. & C.	2641L	.....	....	181	5.2	.....	0	382.8	8.2	521.8	3.3	701.4	74
75	Davis Coal & Coke Co. No. 75	Union	Davis C. & C.	2700B	.....	....	160.5	4.5	318.8	0.3	352.3	6.3	.....	....	362.8	75
76	Davis Coal & Coke Co. No. 76	Union	Davis C. & C.	2735B	.....	....	72	5.7	.....	0	265.5	8.2	.....	....	275.5	76
77	Davis Coal & Coke Co. No. 77	Union	Davis C. & C.	.....	.....	....	38	5.7	197	0.2	228	8.4	.....	....	237.2	77
78	Davis Coal & Coke Co. No. 72	Union	Davis C. & C.	2672L	.....	....	190.8	5.2	.....	0?	391.2	7.8	.....	....	398.9	78
79	Davis Coal & Coke Co. No. 74	Union	Davis C. & C.	2675L	.....	....	138.3	3.5	.....	....	.....	.....	.....	....	163.2	79
80	Davis Coal & Coke Co. No. 66	Union	Davis C. & C.	2750B	.....	....	81	5	224	0.5	260	9.1	.....	....	271	80
81	Davis Coal & Coke Co. No. 65	Union	Davis C. & C.	2715B	.....	....	133	6.3	297	4.6	331	5.8	.....	....	339	81
82	Davis Coal & Coke Co. No. 64	Union	Davis C. & C.	2780B	.....	....	175	5.4	310	2	357	0.2	.....	....	410	82
83	Davis Coal & Coke Co. No. 70	Union	Davis C. & C.	2639L	.....	....	241.6	3.4	.....	0?	424.9	6.1	.....	....	431	83

Summarized Record of Tests for Coal in Grant County (Concluded).

No. on Map IV.	NAME OF PROPERTY.	Magisterial District.	Company.	Elevation above Tide.	Elk Lick ("Barton," "Four-foot") Coal.		Bakerstown ("Thomas") Coal.		Mahoning ("Six-foot") Coal.		Up. Freeport ("Davis," "Split-six") Coal.		Lower Kittanning Coal.		Total Depth.	No. on Map IV.
					Depth. Top.	Thickness. Feet.	Depth. Top.	Thickness. Feet.	Depth. Top.	Thickness. Feet.	Depth. Top.	Thickness. Feet.	Depth. Top.	Thickness. Feet.		
84	Davis Coal & Coke Co. No. 67	Union	Davis C. & C.	2670B	.....	....	233	5	.....	0	391	10	.....	....	440	84
85	Davis Coal & Coke Co. No. 62	Union	Davis C. & C.	2701L	.....	....	.....	0	426.5	0.8	457.8	6.7	.....	....	473	85
86	Davis Coal & Coke Co. No. 63	Union	Davis C. & C.	2757L	.....	....	150.4	4.9	340.4	0.4	362.4	24.8	.....	....	435	86
87	Davis Coal & Coke Co. No. 51	Union	Davis C. & C.	2868L	.....	....	.....	....	.....	0	177.6	4.2	341.2	1.6	439.6	87
88	Davis Coal & Coke Co. No. 61	Garrett Co., Md.	Davis C. & C.	2699L	.....	....	.....	0	.....	0	.....	0	.....	....	540	88
89	Davis Coal & Coke Co. No. 60	Garrett Co., Md.	Davis C. & C.	2707L	.....	....	247	0.2	.....	0	.....	0	.....	....	487	89
90	Davis Coal & Coke Co. No. 59	Garrett Co., Md.	Davis C. & C.	2710L	97	1	305.2	0.8	.....	0	482	2	.....	....	518	90
91	Davis Coal & Coke Co. No. 50	Union	Davis C. & C.	2814L	.....	....	.....	0	.....	0	393	0.7	521.5	1.1	664.1	91
92	Davis Coal & Coke Co. No. 49	Union	Davis C. & C.	2967L	.....	0	.....	0	590	0.5	620.5	7.3	.....	....	639.3	92
93	Davis Coal & Coke Co. No. 48	Garrett Co., Md.	Davis C. & C.	2966L	179.5	0.3	.....	0	.....	0	606.5	14.9	.....	....	629.4	93
94	Davis Coal & Coke Co. No. 47	Garrett Co., Md.	Davis C. & C.	2712L	.....	....	.....	0	.....	0	400.2	9.8	.....	....	416	94
95	Davis Coal & Coke Co. No. 45	Garrett Co., Md.	Davis C. & C.	2727L	.....	....	.....	0	.....	0	301.8	17.8	.....	....	324.6	95
96	Davis Coal & Coke Co. No. 43	Union (Preston Co.)	Davis C. & C.	2783L	.....	....	.....	....	.....	0	184	18.2	.....	....	215.2.	96
97	Davis Coal & Coke Co. No. 38	Union (Preston Co.)	Davis C. & C.	2922L	.....	....	.....	....	.....	0	156	15.7	.....	....	176	97
98	Davis Coal & Coke Co. No. 40	Fairfax (Tucker Co.)	Davis C. & C.	2853L	.....	....	.....	....	.....	0	190.5	5.2	.....	0	297	98
99	Davis Coal & Coke Co. No. 44	Fairfax (Tucker Co.)	Davis C. & C.	2980L	.....	0	.....	0	.....	0	.....	0	.....	....	560	99
100	Davis Coal & Coke Co. No. 33	Fairfax (Tucker Co.)	Davis C. & C.	.....	.....	....	.....	....	.....	....	.....	....	.....	....	.....	100
101	Davis Coal & Coke Co. No. 36	Fairfax (Tucker Co.)	Davis C. & C.	.....	.....	....	.....	....	.....	....	.....	....	.....	....	.....	101
102	Davis Coal & Coke Co. No. 37	Fairfax (Tucker Co.)	Davis C. & C.	3157L	44.3	1.2	273.7	2.9	.....	0	425.8	2.1	.....	....	492	102
103	Davis Coal & Coke Co. No. 120	Fairfax (Tucker Co.)	Davis C. & C.	3175L	.....	....	165	1.5	.....	0	292	5.2	.....	....	299	103
104	Davis Coal & Coke Co. No. 32	Fairfax (Tucker Co.)	Davis C. & C.	.....	.....	....	.....	....	.....	....	.....	....	.....	....	.....	104
105	Davis Coal & Coke Co. No. 30	Fairfax (Tucker Co.)	Davis C. & C.	.....	.....	....	.....	....	.....	....	.....	....	.....	....	.....	105
106	Davis Coal & Coke Co. No. 31	Fairfax (Tucker Co.)	Davis C. & C.	3080L	.....	0	.....	0	.....	0	498.7	2.2	.....	....	579	106
107	Davis Coal & Coke Co. No. 12	Fairfax (Tucker Co.)	Davis C. & C.	2995B	.....	....	180.5	5.5	326	2	366.5	5	.....	....	381	107
108	Davis Coal & Coke Co. No. 11	Fairfax (Tucker Co.)	Davis C. & C.	3100L	.....	....	244	8.3	.....	....	431.1	14.2	.....	....	447	108
109	Davis Coal & Coke Co. No. 34	Fairfax (Tucker Co.)	Davis C. & C.	3124L	.....	....	190.4	4.2	347.3	0.2	392.2	3.2	.....	....	463	109
110	Davis Coal & Coke Co. No. 35	Fairfax (Tucker Co.)	Davis C. & C.	3108L	.....	....	73.2	5.8	.....	0	.....	0	.....	....	296	110
111	Davis Coal & Coke Co. No. 117	Davis (Tucker Co.)	Davis C. & C.	3262L	.....	....	200.8	6.8	.....	....	.....	....	.....	....	208.3	111
112	Davis Coal & Coke Co. No. 119	Davis (Tucker Co.)	Davis C. & C.	3168L	.....	....	140	4.8	.....	....	.....	....	.....	....	146	112
113	Davis Coal & Coke Co. No. 55	Davis (Tucker Co.)	Davis C. & C.	3116L	.....	....	.....	....	.....	....	146.9	6.6	.....	....	155.5	113
114	Davis Coal & Coke Co. No. 52	Davis (Tucker Co.)	Davis C. & C.	3187L	.....	....	.....	0	.....	0	259.8	4.2	.....	0	483	114
115	Davis Coal & Coke Co. No. 56	Davis (Tucker Co.)	Davis C. & C.	3150L	.....	....	.....	....	166.3	2.2	197.2	6.2	.....	....	205	115
116	Davis Coal & Coke Co. No. 121	Davis (Tucker Co.)	Davis C. & C.	.....	.....	....	36.2	3.1	190	2	222.3	7.1	.....	....	234	116

DETAILED COAL TEST RECORDS, PIEDMONT DISTRICT, MINERAL COUNTY.

In Piedmont District no coal tests have been bored but just across the line in Garrett County, Maryland, the **Davis Coal & Coke Company No. —** (No. 5 on Map II) and the **Eva Duckworth Nos. 1 and 2** (Nos. 6 and 7 on Map II), all located on the mountain north of Savage River, have some bearing on the structure and coal resources of the district. The records of these holes are not available for publication.

DETAILED COAL TEST RECORDS, ELK DISTRICT, MINERAL COUNTY.

In Elk District 10 coal tests have been made, as listed in the Table of Summarized Records, their location being principally on Deep Run and Abram Creek. Of these the following one, only, is available for publication:

Davis Coal & Coke Company No. 115 Coal Test Boring (16).

Elk District; on Abram Creek, 0.6 mile west of Wabash; authority, Davis Coal & Coke Company; completed, May 27, 1911; elevation, 2120′ B.

	Thickness.		Total.	
	Ft.	In.	Ft.	In.
Sandstone and boulders	14	0	14	0
Sand	11	0	25	0
Shale, mixed	7	0	32	0
Limestone	11	0	43	0
Shale, blue, sandy	7	0	50	0
Sandstone	23	0	73	0
Shale, black	0	9	73	9
Coal, Bakerstown ("Thomas")	2	8	76	5
Shale, dark, sandy	2	7	79	0
Sandstone, shaly	30	0	109	0
Sandstone, medium-hard	18	0	127	0
Shale, blue, sandy	7	0	134	0
Sandstone, **Buffalo**	35	0	169	0
Shale, dark, **Brush Creek**	1	0	170	0
Shale, gray, sandy	4	0	174	0
Shale, soft, gray	16	0	190	0
Shale, gray, sandy	5	0	195	0
Shale, soft, gray	9	0	204	0
Sandstone, medium-hard, **Upper Mahoning**	8	0	212	0
Shale, gray	8	0	220	0
Shale, dark	6	6	226	6
Shale, dark, **coal partings, Mahoning ("Six-foot")**	0	4	226	10
Shale, dark	12	2	239	0
Shale, dark-gray	15	0	254	0
Sandstone, hard, **Lower Mahoning**	6	0	260	0
Shale, dark	4	7	264	7

Photo by E. E. HARRIS.

PLATE XXVI.—East quarry of Standard Lime and Stone Company at Keyser. Shaly limestone at right is Bossardville. Limestone at left with checkered weathering is Rondout. See Limestone Run Section and Plate XXV.

		Thickness. Ft.	Thickness. In.	Total. Ft.	Total. In.
Coal ..... 1′ 3″ Shale, dark .... 1 5 Shale, dark, coal partings 1 7	Upper Freeport ("Split-six," "Davis")	4	3	268	10
Fire clay		4	2	273	0
Sandstone, shaly ..... 12′ 0″ Sandstone, hard, to bottom 5 0	Upper Freeport	17	0	290	0

DETAILED COAL TEST RECORDS, UNION DISTRICT, GRANT COUNTY.

In Union District, Grant County, 44 coal tests have been made, besides 32 others in Garrett County, Maryland, and 23 in Tucker County and 2 in Preston County, West Virginia, that have bearing on the structure and coal resources of Grant County. On Johnnycake Run of Abram Creek, along the Stony River Syncline, the two following records are available:

Davis Coal & Coke Company No. 114 Coal Test Boring (18).

Union District; on Abram Creek, at the mouth of Johnnycake Run, 3 miles northeast of Mount Storm; authority, Davis Coal & Coke Company; completed, July 1, 1911; elevation, 2273′ L.

		Thickness. Ft.	Thickness. In.	Total. Ft.	Total. In.
Sand and clay		7	0	7	0
Hard conglomerate ..... 7′ 0″ Sandstone, hard 3 0	Saltsburg?	10	0	17	0
Shale, gray		42	0	59	0
Shale, gray, sandy		16	0	75	0
Shale, dark		2	10	77	10
Bone ..... 0′ 8″ Shale, dark, with coal partings ..... 0 6 Bone coal ..... 0 3 Coal 2 0	Bakerstown ("Thomas")	3	5	81	3
Fire clay		7	9	89	0
Shale, gray, sandy		13	0	102	0
Shale, soft, sticky, gray		23	0	125	0
Shale, tough, blue		6	0	131	0
Sandstone, medium-hard, Buffalo		27	0	158	0
Shale, sandy		22	0	180	0
Shale, limy, with limestone bands		10	0	190	0
Shale, sticky, mixed		13	0	203	0
Shale, blue		9	0	212	0
Shale, mixed		5	0	217	0
Shale, blue		3	0	220	0
Shale, gray		10	0	230	0

		Thickness. Ft.	Thickness. In.	Total. Ft.	Total. In.
Sandstone 8′ 0″ Shale, gray, with sandstone bands 13 0	Lower Mahoning	21	0	251	0
Shale, dark, **Uffington**		6	8	257	8
Coal, bony 0′ 7″ **Coal**, dirty 0 9 Shale, dark 0 8 **Coal** 0 10 Shale, dark 0 9 **Coal** 0 3	Upper Freeport ("Split-six," "Davis")	3	10	261	6
Fire clay, to bottom		1	6	263	0

Davis Coal & Coke Company No. 113 Coal Test Boring (19).

Union District; on Johnnycake Run of Abram Creek, 2.6 miles northeast of Mount Storm; authority, Davis Coal & Coke Company; completed, July 1, 1911; elevation, 2325′ B.

		Thickness. Ft.	Thickness. In.	Total. Ft.	Total. In.
Sand		3	0	3	0
Sand and boulders		10	0	13	0
Sand and gravel		10	0	23	0
Shale, soft, dark, **Ames**		3	2	26	2
Coal 1′ 6″ **Coal**, slaty 1 3	Harlem	2	9	28	11
Shale, soft, gray		10	1	39	0
Shale, gray		11	0	50	0
Limestone, broken		18	0	68	0
Sandstone, hard 11′ 0″ Conglomerate 4 0 Sandstone, hard 15 0	Jane Lew? or Saltsburg?	30	0	98	0
Shale, gray		3	0	101	0
Limestone		3	0	104	0
Shale, mixed		8	0	112	0
Shale, blue, limestone bands		11	0	123	0
Shale, blue, sandy		13	0	136	0
Shale, sandy		5	0	141	0
Shale, dark		1	10	142	10
Coal, bony 1′ 2″ **Coal** 2 9	Bakerstown ("Thomas")	3	11	146	9
Shale, dark		3	3	150	0
Fire clay		17	0	167	0
Sandstone, shaly 2′ 0″ Sandstone, hard 4 0 Shale, gray, sandy 7 0 Sandstone, medium-hard 39 0	Buffalo	52	0	219	0
Shale, gray		21	0	240	0
Shale, gray, sandy		5	0	245	0
Shale, gray, sticky		18	0	263	0
Shale, mixed		30	0	293	0
Shale, blue		10	0	303	0
Shale, dark-gray		16	0	319	0

	Thickness. Ft.	In.	Total. Ft.	In.
Shale, gray, with sandstone bands, **Lower Mahoning Sandstone**	13	0	332	0
Shale, dark, **Uffington**	8	2	340	2
Coal, slaty.....1′ 4″ **Bone coal** .....0 8 **Coal** .....0 6 — **Upper Freeport ("Split-six," "Davis")**	2	6	342	8
Shale, gray, sandy	6	6	349	2
Sandstone, **Upper Freeport**, to bottom	2	0	351	2

On the waters of Stony River 13 holes have been bored, the locations of which are shown on Map IV and the property names of which appear in the Table of Summarized Coal Test Records, but none of these are available for publication.

Farther southwest along the Stony River Basin in Dry Fork District, Tucker County, four tests have been bored on the lands of the **Robert Bridges Heirs** on the waters of Stonecoal Run of Red Creek northeast of Laneville. The detailed records of these have been published in the Tucker County Report of the Survey, pages 141, 143, 357, and 358.

In Garrett County, Maryland, the **W. D. Althouse & Co. Nos. 1 and 2 (Nos. 37 and 38 on Map IV)**, located in a ravine on the north side of the Potomac one-half mile southwest of Gorman, are not available for publication. In the same county the **C. E. Hilleary No. 1 (No. 38A on Map IV)** is reported by Mr. R. A. Smith, of Blaine, as having showed 3′ 7″ of good coal at 322 feet, which would be at the Bakerstown ("Thomas") horizon, and as having only thin streaks of coal at 522 feet where the Upper Freeport ("Split-six") should have been found. No information of value could be gained as to the history of the **J. W. King No. 1 (No. 38B on Map IV)**, located on a branch of Glade Run, 1 mile southwest of Kearney, in the same county.

On the waters of Buffalo Creek southeast and south of Bayard there have been 13 tests but their records are not available for publication.

On the Maryland side 4 holes have been bored on the waters of Shields Run and define the position of the North Potomac Syncline but their publication is not authorized. The record of the **Davis Coal and Coke Co. No. 84 (No. 57 on Map IV)**, located on the ridge west of the Potomac and 1 mile north of Wilson, has been published as the Wilson Section, page 179. The eight following records give valuable coal data as well as defining the course of the basin between Wilson and Kempton in the edge of Maryland:

Davis Coal & Coke Company No. 88 Coal Test Boring (58).

Garrett County, Maryland; on North Branch of Potomac River at Wilson; authority, Davis Coal & Coke Company; elevation, 2520′ L.

	Thickness. Ft.	Thickness. In.	Total. Ft.	Total. In.
Sand and gravel	20	0	20	0
Shale, light	8	0	28	0
Shale, dark	20	0	48	0
Sandstone, **Grafton**	1	2	49	2
Shale, dark, **Ames**	2	7	51	9
Coal, Harlem	0	11	52	8
Fire clay	15	0	67	8
Shale, light	7	4	75	0
Shale, red	3	0	78	0
Fire clay, shaly	3	0	81	0
Shale, red	3	3	84	3
Shale, light	0	10	85	1
Shale, red	15	0	100	1
Shale, light, sandy	16	0	116	1
Shale, red	1	5	117	6
Shale, light	8	6	126	0
Shale, red	2	0	128	0
Fire clay, shaly	3	6	131	6
Shale, red	4	0	135	6
Shale, light	28	0	163	6
Fire clay, shaly	1	8	165	2
Shale, light	6	0	171	2
Fire clay, dark, shaly	2	2	173	4
Slate, black	0	4	173	8
Coal 3′ 1″ Slate, black 0 2 **Coal** 0 1 — **Bakerstown ("Thomas")**	3	4	177	0
Fire clay, shaly	0	4	177	4
Shale, light	3	0	180	4
Shale, sandy	6	0	186	4
Sandstone	16	0	202	4
Fire clay, shaly	8	0	210	4
Sandstone, hard, **Buffalo**	4	6	214	10
Shale, sandy	7	0	221	10
Shale, red	6	0	227	10
Shale, sandy	19	0	246	10
Shale, dark	0	4	247	2
Shale, sandy	0	4	247	6
Shale, dark	0	4	247	10
Shale, sandy	12	0	259	10
Shale, dark, **Brush Creek**	4	2	264	0
Coal, Brush Creek	0	7	264	7
Shale, dark	0	2	264	9
Slate, black	0	1	264	10
Fire clay, shaly	1	4	266	2
Shale, sandy	6	0	272	2
Sandstone	1	0	273	2
Shale, gray	7	0	280	2
Sandstone 5′ 0″ Fire clay, shaly 18 0 Sandstone, hard 9 0 — **Upper Mahoning Sandstone**	32	0	312	2

	Thickness. Ft.	In.	Total. Ft.	In.
Shale, limy	1	9	313	11
Shale, light	6	0	319	11
Shale, sandy	2	0	321	11
Shale, gray	4	0	325	11
Shale, dark	10	0	335	11
Shale, gray	4	0	339	11
Shale, sandy	7	6	347	5
Sandstone ....3′ 6″ Shale, dark ..6 6 Sandstone .....0 5 } **Lower Mahoning**	10	5	357	10
Shale, sandy	1	3	359	1
Shale, dark	18	0	377	1
Shale and sandstone	1	0	378	1
Slate, black, **Uffington**	3	4	381	5
Coal .....0′ 8″ Binder .....0 0¾ **Coal** .....0 2¾ Binder .....0 0½ **Coal** .....0 10¼ Binder .....0 0⅜ **Coal** .....1 2⅜ Binder .....0 6½ **Coal** .....2 7 Binder .....0 0¾ **Coal** .....1 11¼ } **Upper Freeport ("Split-six," "Davis")**	8	2½	389	7½
Fire clay, to bottom	2	1½	391	9

Davis Coal and Coke Company No. 83 Coal Test Boring (63).

Garrett County, Maryland; on South Fork of Sand Run of North Branch of Potomac River, 1.7 miles northwest of Wilson; authority, Davis Coal & Coke Company; completed, February 12, 1915; elevation, 2632′ L.

	Thickness. Ft.	In.	Total. Ft.	In.
Clay and gravel	31	0	31	0
Shale, light	30	0	61	0
Sandstone, **Barton**	14	0	75	0
Coal, Elk Lick	0	4	75	4
Sandstone, hard, **Upper Grafton**	42	8	118	0
Shale and limestone	30	0	148	0
Shale	14	0	162	0
Sandstone, **Grafton**	17	0	179	0
Shale, dark, **Ames**	2	0	181	0
Sandstone, hard	4	0	185	0
Shale and slate	6	0	191	0
Sandstone, hard	2	0	193	0
Fire clay	10	0	203	0
Sandstone, hard, **Jane Lew**	17	0	220	0
Shale, light	34	0	254	0
Slate	0	6	254	6
Fire clay	9	6	264	0
Shale, sandy	9	0	273	0
Sandstone, **Thomas**	5	0	278	0

	Thickness. Ft.	In.	Total. Ft.	In.
Slate, black, **Bakerstown ("Thomas") Coal horizon**	20	0	298	0
Shale, sandy	6	0	304	0
Shale, variegated	29	0	333	0
Sandstone, crystallized, **Buffalo**	39	0	372	0
Shale, dark, **Brush Creek**	5	0	377	0
Sandstone	4	0	381	0
Shale, dark, sandy	4	0	385	0
Sandstone ....12′ 0″ Shale, sandy 4 0 Sandstone ....14 0 } **Upper Mahoning**	30	0	415	0
Shale, dark, **Mahoning ("Six-foot") Coal horizon**	15	0	430	0
Fire clay	9	0	439	0
Shale, gray	14	0	453	0
Sandstone, **Lower Mahoning**	23	0	476	0
Slate, black, **Uffington**	10	2½	486	2½
Coal ....1′ 7″ Slate ....0 1 **Coal** ....1 10 Slate ....0 7 **Coal** ....1 6½ Slate ....0 1½ **Coal** ....0 9 Slate ....0 1½ **Coal** ....1 9 } **Upper Freeport ("Split-six," "Davis")**	8	4½	494	7
Fire clay, to bottom	2	5	497	0

Davis Coal & Coke Company No. 103 Coal Test Boring (65).

Garrett County, Maryland; on Laurel Run of North Branch of Potomac River, 0.6 mile northwest of Dobbin; authority, Davis Coal & Coke Company; completed, April 15, 1915; elevation, 2580′ L.

	Thickness. Ft.	In.	Total. Ft.	In.
Surface	15	0	15	0
Shale, light	24	0	39	0
Slate	8	0	47	0
Coal, Elk Lick ("Barton," "Four-foot")	1	8	48	8
Fire clay	10	4	59	0
Shale, light	38	0	97	0
Fire clay	8	0	105	0
Shale, red	9	0	114	0
Shale, light	12	0	126	0
Fire clay	11	0	137	0
Sandstone, hard .... 4′ 0″ Shale, sandy .... 2 0 Sandstone, hard ....10 0 } **Grafton**	16	0	153	0
Slate, **Ames Shale**	1	6	154	6
Coal, Harlem	1	6	156	0
Fire clay	6	0	162	0
Shale, sandy	7	0	169	0
Sandstone, **Jane Lew**	14	0	183	0
Fire clay	9	0	192	0
Shale, sandy	15	0	207	0

	Thickness. Ft.	In.	Total. Ft.	In.
Sandstone, **Saltsburg**	10	0	217	0
Shale and fire clay	11	0	228	0
Sandstone, **Thomas**	14	0	242	0
Shale, variegated, and fire clay	3	0	245	0
Shale, sandy	24	0	269	0
Coal, bony 2′ 0″ Slate 0 2 **Coal** 2 2 — **Bakerstown ("Thomas")**	4	4	273	4
Fire clay	8	8	282	0
Shale, sandy	11	0	293	0
Sandstone, **Buffalo**	20	0	313	0
Shale, sandy	33	0	346	0
Sandstone, **Upper Mahoning**	36	0	382	0
Shale, sandy	35	0	417	0
Sandstone, **Lower Mahoning**	32	0	449	0
Slate, **Uffington**	5	0	454	0
Coal 0′ 7″ Slate 0 1½ **Coal** 2 8 Slate 0 7 **Coal** 2 7½ Slate 0 0½ **Coal** 1 4½ — **Upper Freeport ("Split-six," "Davis")**	8	0	462	0
Fire clay, to bottom	2	0	464	0

Davis Coal & Coke Company No. 79 Coal Test Boring (68).

Garrett County, Maryland; on a branch of Laurel Run of North Branch of Potomac River, 1.6 miles northwest of Dobbin; authority, Davis Coal & Coke Company; completed, February 23, 1915; elevation, 2717′ L.

	Thickness. Ft.	In.	Total. Ft.	In.
Sand and gravel	16	0	16	0
Sandstone, **Morgantown**	24	0	40	0
Fire clay and shale	12	0	52	0
Shale, gray	30	0	82	0
Sandstone, **Barton**	27	0	109	0
Shale, gray, sandy	6	0	115	0
Sandstone	3	6	118	6
Shale, dark	13	0	131	6
Coal, Elk Lick ("Barton," "Four-foot")	0	6	132	0
Fire clay and shale	9	0	141	0
Fire clay	7	3	148	3
Shale, gray	6	9	155	0
Shale, gray, sandy	18	6	173	6
Fire clay	3	0	176	6
Shale, red and gray	4	6	181	0
Fire clay	4	0	185	0
Shale, gray, sandy	7	0	192	0
Sandstone, hard, **Grafton**	44	0	236	0
Shale, dark-gray, **Ames**	2	0	238	0

	Thickness. Ft.	Thickness. In.	Total. Ft.	Total. In.
Coal, Harlem	1	1	239	1
Fire clay	5	0	244	1
Fire clay and shale	10	11	255	0
Shale, red and gray	17	0	272	0
Shale, gray, with lime spots	5	0	277	0
Shale, red and gray	2	0	279	0
Shale, gray, sandy, with lime spots	32	0	311	0
Shale, variegated	4	4	315	4
Shale, gray	6	0	321	4
Shale, red and gray	4	8	326	0
Shale, gray, and lime	15	6	341	6
Shale, gray, sandy	10	6	352	0
Shale and sandrock	7	0	359	0
Shale, dark-blue	1	5	360	5
Fire clay	0	7	361	0
Shale, dark	2	4	363	4
Sandstone, **Thomas**	9	0	372	4
Shale, gray, sandy	5	0	377	4
Shale, variegated	5	8	383	0
Fire clay and shale	11	0	394	0
Lime and fire clay	4	0	398	0
Fire clay	7	0	405	0
Shale, gray, sandy	1	0	406	0
Fire clay and shale	4	0	410	0
Rock, hard, sandy	14	0	424	0
Shale, dark-gray	3	0	427	0
Shale, dark	5	0	432	0
Fire clay and shale	2	6	434	6
Shale, gray, sandy	13	6	448	0
Sandstone, **Buffalo**	5	0	453	0
Shale, dark, **Brush Creek**	0	4	453	4
Shale, gray, sandy	4	10	458	2
Fire clay	7	0	465	2
Shale, gray, sandy, with lime spots	36	0	501	2
Sandstone and shale	4	4	505	6
Shale, dark	0	8	506	2
Fire clay	3	0	509	2
Shale, gray, sandy	23	10	533	0
Fire clay and shale	14	0	547	0
Fire clay	3	0	550	0
Shale, dark, and fire clay	11	6	561	6
Sandstone 4′ 8″ Shale, dark, sandy 2 0 Slate, black 4 0 Sandrock and shale 5 0 — **Lower Mahoning**	15	8	577	2
Slate, black, **Uffington**	3	3	580	5
Coal 1′ 2″ Slate 0 1 **Coal** 2 6½ Slate 0 10 **Coal** 3 6 Slate 0 1 **Coal** 1 8 — **Upper Freeport ("Split-six," "Davis")**	9	10½	590	3½
Fire clay, to bottom	2	8½	593	0

Davis Coal & Coke Company No. 68 Coal Test Boring (69).

Garrett County, Maryland; on Laurel Run of North Branch of Potomac River, 2 miles northwest of Henry; authority, Davis Coal & Coke Company; completed, April 2, 1915; elevation, 2637' L.

	Thickness. Ft.	Thickness. In.	Total. Ft.	Total. In.
Clay and gravel	25	0	25	0
Sandrock	6	0	31	0
Shale, gray	8	0	39	0
Fire clay and shale	12	0	51	0
Shale, dark, sandy	7	0	58	0
Fire clay and shale, with lime traces	14	0	72	0
Shale, gray, sandy	4	0	76	0
Shale, dark, sandy, **Ames**	22	6	98	6
Coal, Harlem	1	2	99	8
Fire clay and shale	19	4	119	0
Shale, red and gray	5	0	124	0
Shale, gray, sandy, with lime spots	10	5	134	5
Shale, red and gray	11	0	145	5
Shale, gray, sandy, with lime traces	8	7	154	0
Shale, gray, sandy	9	0	163	0
Shale, red	5	0	168	0
Shale, gray, sandy	9	0	177	0
Fire clay and shale	7	0	184	0
Shale, red and gray	5	6	189	6
Shale, gray, sandy	16	6	206	0
Fire clay and shale	10	0	216	0
Fire clay and limestone	5	6	221	6
Fire clay and shale	6	6	228	0
Fire clay, with lime spots	4	0	232	0
Shale, gray, sandy, with lime traces	12	6	244	6
Sandstone, **Buffalo**	10	0	254	6
Shale, gray, sandy, with lime spots	16	0	270	6
Shale, dark	2	6	273	0
Sandrock	1	6	274	6
Fire clay	5	6	280	0
Shale, gray, sandy	6	6	286	6
Shale, dark, sandy 3' 3" / Slate, black 4 3 — **Brush Creek**	7	6	294	0
Coal, bony, Brush Creek	0	3	294	3
Shale, dark, sandy	2	0	296	3
Shale, gray, sandy, with lime traces	16	6	312	9
Shale, dark	0	8	313	5
Shale, gray, sandy	6	7	320	0
Sandrock and shale	6	0	326	0
Fire clay	5	0	331	0
Fire clay and shale	3	6	334	6
Shale, gray, sandy	28	0	362	6
Sandstone 2' 0" / Shale, gray, sandy 2 6 / Sandstone 7 0 — **Upper Mahoning**	11	6	374	0
Fire clay and shale	13	0	387	0
Fire clay	6	4	393	4
Shale, red and gray, **Mahoning**	2	8	396	0
Shale, gray, sandy	10	0	406	0

	Thickness. Ft.	In.	Total. Ft.	In.
Fire clay and shale, dark	6	6	412	6
Shale, gray, sandy	14	0	426	6
Shale, dark, and sandstone	5	6	432	0
Shale, dark, Uffington	0	6	432	6
Coal 0′ 11″ Binder 0 2½ Coal 3 4½ Binder 0 8 Coal 4 0 — Upper Freeport ("Split-Six," "Davis")	9	2	441	8
Fire clay, to bottom	0	4	442	0

Davis Coal & Coke Company No. 58 Coal Test Boring (70).

Garrett County, Maryland; on the head of Laurel Run of North Branch of Potomac River, 1.1 miles northward from Kempton; authority, Davis Coal & Coke Company; completed, February 7, 1915; elevation, 2656′ L.

	Thickness. Ft.	In.	Total. Ft.	In.
Clay and gravel	20	0	20	0
Ledge, decomposed	5	0	25	0
Ledge, decomposed	10	0	35	0
Slate, gray	2	0	37	0
Slate, black, with streak of coal	1	0	38	0
Slate, gray	45	0	83	0
Shale, soft, muddy	17	0	100	0
Slate, gray	27	0	127	0
Sandstone	8	0	135	0
Shale, red	12	0	147	0
Shale, sandy	8	0	155	0
Shale, gray	15	0	170	0
Slate, black, Brush Creek	12	0	182	0
Coal, Brush Creek	1	0	183	0
Shale, gray	21	0	204	0
Shale, hard, flint	10	0	214	0
Shale, gray	10	0	224	0
Sandstone 9′ 0″ Sandstone, hard, crystallized 31 0 — Upper Mahoning	40	0	264	0
Shale, hard, dark	7	0	271	0
Sandstone, dark, Lower Mahoning	15	0	286	0
Shale, gray	1	0	287	0
Slate, black, Uffington	2	7	289	7
Coal 0′ 3″ Slate 0 6 Coal 1 5 Slate 0 5 Coal 2 11 Slate 0 9 Coal 3 11 — Upper Freeport ("Split-six," "Davis")	10	2	299	9
Fire clay	3	3	303	0
Slate, soft, gray, to bottom	9	0	312	0

Davis Coal & Coke Company No. 57 Coal Test Boring (71).

Garrett County, Maryland; on the head of Laurel Run of North Branch of Potomac River, 0.7 mile north of Kempton; authority, Davis Coal & Coke Company; completed, January 4, 1913; elevation, 2730′ L.

	Thickness. Ft.	In.	Total. Ft.	In.
Clay and boulders	7	0	7	0
Shale, sandy	17	0	24	0
Shale, red	10	0	34	0
Shale, sandy	15	0	49	0
Soapstone or fire clay	10	0	59	0
Shale, sandy	53	0	112	0
Slate, black	5	0	117	0
Fire clay, soft	4	0	121	0
Shale, sandy	10	0	131	0
Lime rock	3	0	134	0
Shale, sandy	12	0	146	0
Limestone	2	0	148	0
Shale, hard, sandy	30	0	178	0
Rock, hard, smooth, **Buffalo**	15	0	193	0
Shale, red	6	0	199	0
Shale, sandy	18	0	217	0
Slate, hard, black	6	0	223	0
Limestone	3	0	226	0
Shale, sandy	41	0	267	0
Sandstone, hard, **Upper Mahoning**	20	0	287	0
Shale, hard, sandy	15	0	302	0
Shale, soft, sandy	23	0	325	0
Coal 1′ 4″ Slate 0 1 **Coal** 2 5 Slate, sandy 2 2 **Coal** 2 6 — **Upper Freeport ("Split-six," "Davis")**	8	6	333	6
Fire clay, hard, sandy, to bottom	10	0	343	6

Davis Coal & Coke Company No. 46 Coal Test Boring (72).

Garrett County, Maryland; on North Branch of Potomac River, 0.5 mile northward from Kempton; authority, Davis Coal & Coke Company; completed, January 21, 1913; elevation, 2947′ L.

	Thickness. Ft.	In.	Total. Ft.	In.
Sand and gravel	28	0	28	0
Shale, broken, with slate	27	0	55	0
Slate, black	8	0	63	0
Shale, red	11	0	74	0
Shale, blue	31	0	105	0
Shale, red	2	0	107	0
Shale, blue	16	0	123	0
Shale, gray	20	0	143	0
Shale, dark	13	0	156	0
Shale, gray	41	0	197	0
Shale, red	12	0	209	0
Sandstone, **Upper Grafton**	10	0	219	0

	Thickness. Ft.	In.	Total. Ft.	In.
Shale, red	4	0	223	0
Sandstone, **Grafton**	16	0	239	0
Shale, gray	10	0	249	0
Shale, dark, **Ames**	9	0	258	0
Bone coal, Harlem	0	8	258	8
Shale, black	0	4	259	0
Shale, gray, muddy	18	0	277	0
Shale, red	7	0	284	0
Shale, gray	5	0	289	0
Shale, red	9	0	298	0
Shale, blue	33	6	331	6
Slate, black	1	6	333	0
Coal	0	2	333	2
Shale, blue	21	10	355	0
Sandstone, **Jane Lew**	25	0	380	0
Slate, black	9	0	389	0
Shale, soft, gray	10	0	399	0
Shale, sandy	10	0	409	0
Shale, soft	9	0	418	0
Shale, soft, gray	10	0	428	0
Sandstone, **Saltsburg**	5	0	433	0
Shale, gray	10	0	443	0
Shale, muddy	6	0	449	0
Shale, gray	3	0	452	0
Shale, muddy	6	0	458	0
Shale, gray	13	0	471	0
Slate, gray	2	0	473	0
Slate, black, **Brush Creek**	14	0	487	0
Coal, Brush Creek	1	6	488	6
Shale, muddy	20	6	509	0
Soapstone	3	0	512	0
Shale, limy	10	0	522	0
Shale, blue	10	0	532	0
Shale, spotted	9	0	541	0
Shale, blue	14	0	555	0
Sandstone, hard, **Upper Mahoning**	13	0	568	0
Shale, dark	3	0	571	0
Sandstone, **Lower Mahoning**	4	0	575	0
Shale, broken	4	0	579	0
Shale, gray	12	10	591	10
Coal ..... 0′ 11″ Binder .. 0 1 **Coal** ..... 4 4 Slate ..... 1 6 **Coal** ..... 2 1½ — **Upper Freeport ("Davis," "Split-six")**	8	11½	600	9½
Shale, gray, sticky, to bottom	6	9½	607	7

The record of the **Davis Coal & Coke Company No. 81 (No. 73 on Map IV)**, located on the Maryland side, one-half mile southwest of Dobbin, has been published as the Dobbin Section, page 181; and the record of the **Davis Coal & Coke Company No. 73 (No. 74 on Map IV)**, located on the West Virginia side at Henry, has been used as the Henry Section, pages 184-7. The ten following records are those of holes bored

along the Potomac, or on short tributaries, between Henry and Wilsonia, all on the West Virginia side of the Potomac:

Davis Coal & Coke Company No. 75 Coal Test Boring (75).

Union District; on Elk Run of North Branch of Potomac River, 0.4 mile southeast of Henry; authority, Davis Coal & Coke Company; completed, October 23, 1914; elevation, 2700′ B.

	Thickness.		Total.	
	Ft.	In.	Ft.	In.
Clay and gravel	15	0	15	0
Shale, light	18	0	33	0
Slate, black, **Ames**	6	0	39	0
Coal, Harlem	1	0	40	0
Fire clay	4	0	44	0
Lime and shale	10	0	54	0
Sandstone, hard, **Jane Lew**	9	0	63	0
Lime and fire clay	5	0	68	0
Shale and fire clay	15	0	83	0
Shale, gray	5	0	88	0
Sandstone, hard	2	0	90	0
Shale, blue and red	10	0	100	0
Limestone	1	6	101	6
Lime and shale	9	0	110	6
Shale, red	4	0	114	6
Shale, gray	20	0	134	6
Shale, blue, hard	5	6	140	0
Sandstone, **Saltsburg**	5	0	145	0
Shale, dark, sandy, with coal partings, **Upper Bakerstown**	6	0	151	0
Sandstone, **Thomas**	7	0	158	0
Slate, black	2	6	160	6
Coal and bone .. 1′ 4″ Binder ..... 0 2½ Coal ..... 3 0 } **Bakerstown ("Thomas")**	4	6½	165	0½
Shale, hard	3	6	168	6½
Limestone, **Pine Creek**	1	0	169	6½
Fire clay	10	0	179	6½
Shale, dark	10	0	189	6½
Sandstone, hard, **Buffalo**	16	0	205	6½
Shale, sandy	8	0	213	6½
Sandstone	4	0	217	6½
Shale, sandy	5	0	222	6½
Slate, black, **Brush Creek**	7	3	229	9½
Coal, Brush Creek	0	8	230	5½
Shale, light, sandy	26	4	256	9½
Shale, dark	4	0	260	9½
Shale, light	9	0	269	9½
Shale, green, with sand partings	21	0	290	9½
Shale, dark	4	0	294	9½
Shale, light, sandy	6	0	300	9½
Sandstone ..... 8′ 0″ Fire clay ..... 2 0 Sandstone, light 5 0 } **Upper Mahoning**	15	0	315	9½
Shale, dark	3	0	318	9½

	Thickness. Ft.	In.	Total. Ft.	In.
Coal, Mahoning ("Six-foot")	0	4	319	1½
Shale, hard	7	0	326	1½
Lime and fire clay	6	8	332	9½
Shale, light, sandy	12	0	344	9½
Sandstone, hard, Lower Mahoning	4	0	348	9½
Slate	3	6	352	3½
Coal 1′ 3″ / Binder 0 6 / Coal 4 7 — Upper Freeport ("Split-six," "Davis")	6	4	358	7½
Fire clay, to bottom	4	2	362	9½

Davis Coal & Coke Company No. 76 Coal Test Boring (76).

Union District; on Elk Run of North Branch of Potomac River, 0.6 mile southeast of Henry; authority, Davis Coal & Coke Company; completed, October 23, 1914; elevation, 2735′ B.

	Thickness. Ft.	In.	Total. Ft.	In.
Clay and gravel	25	0	25	0
Clay and washout	29	0	54	0
Lime and fire clay	4	0	58	0
Shale, sandy	11	0	69	0
Slate	3	0	72	0
Coal, bony 1′ 6″ / Coal 4 2 — Bakerstown ("Thomas")	5	8	77	8
Fire clay	10	4	88	0
Shale and clay	9	0	97	0
Shale, dark	3	0	100	0
Sandstone, hard, Buffalo	17	0	117	0
Shale, dark 22′ 0″ / Slate, dark 6 0 — Brush Creek	28	0	145	0
Coal, Brush Creek	0	6	145	6
Shale, gray	9	0	154	6
Sandstone, hard	10	6	165	0
Shale, dark	3	0	168	0
Fire clay, soft	9	0	177	0
Shale, light, sandy	22	0	199	0
Shale, dark, with coal partings	4	0	203	0
Fire clay	3	0	206	0
Sandstone, hard, Upper Mahoning	6	0	212	0
Shale, hard	3	0	215	0
Shale, hard, sandy	10	0	225	0
Shale, broken	5	0	230	0
Shale, blue, hard	11	0	241	0
Sandstone, Lower Mahoning	3	0	244	0
Shale, gray	6	0	250	0
Shale, sandy	10	0	260	0
Slate, black, Uffington	5	6	265	6
Coal 3′ 4″ / Binder 0 5 / Coal 4 6 — Upper Freeport ("Split-six," "Davis")	8	3	273	9
Fire clay, to bottom	1	9	275	6

Davis Coal & Coke Company No. 77 Coal Test Boring (77).

Union District; on Elk Run of North Branch of Potomac River, 1 mile southeast of Henry; authority, Davis Coal & Coke Company; completed, October 23, 1914; elevation, 2805′ B.?

	Thickness. Ft.	Thickness. In.	Total. Ft.	Total. In.
Clay and gravel	22	0	22	0
Washout	13	0	35	0
Sandstone, **Thomas**	1	6	36	6
Shale, soft	1	6	38	0
Coal, bony 1′ 0″ / **Coal** 4 8 — **Bakerstown ("Thomas")**	5	8	43	8
Fire clay	7	4	51	0
Sandstone, hard, **Buffalo**	55	0	106	0
Slate, black, **Brush Creek**	7	0	113	0
Coal, Brush Creek	1	0	114	0
Shale, dark	1	0	115	0
Shale and fire clay	17	0	132	0
Shale, soft, light	15	0	147	0
Shale, variegated	13	0	160	0
Shale, light	3	0	163	0
Shale, red	5	0	168	0
Shale, blue	6	0	174	0
Shale, variegated	3	0	177	0
Shale, light, sandy	2	0	179	0
Shale, gray	16	0	195	0
Slate, black	2	0	197	0
Coal, Mahoning ("Six-foot")	0	2	197	2
Fire clay	2	0	199	2
Shale, variegated	3	0	202	2
Shale, light	7	0	209	2
Sandstone, hard 4′ 0″ / Shale, gray 3 10 / Sandstone, hard 3 0 / Shale, gray 3 6 / Slate, black 2 0 / Sandstone 1 0 — **Lower Mahoning**	17	4	226	6
Slate, black, **Uffington**	1	6	228	0
Coal 2′ 5″ / Binder 0 9 / **Coal** 3 11 / Binder 0 2 / **Coal** 1 2 — **Upper Freeport ("Split-six," "Davis")**	8	5	236	5
Fire clay, to bottom	0	10	237	3

Davis Coal & Coke Company No. 72 Coal Test Boring (78).

Union District; on Deakin Run of North Branch of Potomac River, 0.3 mile southwest of Henry; authority, Davis Coal & Coke Company; elevaton, 2672′ L.

	Thickness. Ft.	Thickness. In.	Total. Ft.	Total. In.
Strata unknown	190	9	190	9
Coal, Bakerstown ("Thomas")	5	3	196	0
Strata unknown	195	2	391	2
Coal 2′ 0″ / Bone 0 10 / **Coal** 2 10 / Slate 0 1 / **Coal**, to bottom 2 0 — **Upper Freeport ("Split-six," "Davis")**	7	9	398	11

Davis Coal & Coke Company No. 74 Coal Test Boring (79).

Union District; on Deakin Run of North Branch of Potomac River, 0.6 mile southwest of Henry; authority, Davis Coal & Coke Company; elevation, 2675′ L.

	Thickness. Ft.	Thickness. In.	Total. Ft.	Total. In.
Clay and boulders	17	8½	17	8½
Clay, dark, and boulders	2	0	19	8½
Clay, dark	10	3½	30	0
Fire clay, rotten	4	7	34	7
Rock, hard, gray, flint 6′ 3½″ Rock, conglomerate 2 0 Rock, hard, gray, flint 4 2½ } Grafton	12	6	47	1
Fire clay	4	5½	51	6½
Fire clay, light	17	10	69	4½
Fire clay, rotten	1	10½	71	3
Coal, slaty, Harlem	0	4½	71	7½
Fire clay, dark	5	8	77	3½
Fire clay, rotten	7	5	84	8½
Sandstone, gray, Saltsburg	33	2	117	10½
Fire clay	2	10	120	8½
Sandstone, Thomas	13	11	134	7½
Fire clay	1	1½	135	9
Sandstone	0	7	136	4
Bone and slate	2	0	138	4
Coal, Bakerstown ("Thomas")	3	6	141	10
Fire clay	15	0½	156	10½
Fire clay, hard	6	4	163	2½

Davis Coal & Coke Company No. 66 Coal Test Boring (80).

Union District; on a branch of Deakin Run of North Branch of Potomac River, 0.8 mile south of Henry; authority, Davis Coal & Coke Company; completed, October 23, 1914; elevation, 2750′ B.

	Thickness. Ft.	Thickness. In.	Total. Ft.	Total. In.
Clay and gravel	25	0	25	0
Washout	20	0	45	0
Fire clay, shaly	12	0	57	0
Shale, light, sandy	23	0	80	0
Slate, black	1	0	81	0
Coal, bony 1′ 6″ Coal 3 6 } Bakerstown ("Thomas")	5	0	86	0
Shale, hard, dark	13	0	99	0
Fire clay and shale	10	0	109	0
Shale, light, sandy	12	0	121	0
Shale, soft, dark	4	0	125	0
Sandstone, hard, Buffalo	6	0	131	0
Shale, light, sandy	4	0	135	0
Slate, dark, Brush Creek	8	0	143	0
Coal, bony, Brush Creek	1	6	144	6
Shale, dark	1	0	145	6
Shale, gray	13	0	158	6
Limestone	1	0	159	6

Photo by E. E. HARRIS.

PLATE XXVII.—Pittsburgh ("Big Vein") Coal at stripping plant of H. P. Brydon and Bro., Inc. (Mine No. 12 on Map II) in Shores Knob, Mineral County. The top of the coal is plainly visible about 4 feet above top of two-foot rule. Above the roof shales may be seen the Pittsburgh Sandstone.

	Thickness. Ft.	In.	Total. Ft.	In.
Shale and fire clay	10	6	170	0
Shale, light, sandy	14	0	184	0
Shale, gray	7	0	191	0
Sandstone, hard	4	0	195	0
Shale, soft	4	0	199	0
Shale, hard, blue	8	0	207	0
Sandstone, hard 2′ 0″ Shale, light 3 0 Sandstone, hard 1 0 Shale, light, sandy 8 0 } Upper Mahoning	14	0	221	0
Slate, dark	3	0	224	0
Coal, Mahoning ("Six-foot")	0	6	224	6
Fire clay	1	0	225	6
Fire clay, shaly	12	0	237	6
Shale, dark, sandy	2	6	240	0
Rock, white 2′ 0″ Shale, dark, sandy 5 0 Sandstone, hard 3 0 } Lower Mahoning	10	0	250	0
Shale and slate, **Uffington**	10	0	260	0
Coal 1′ 8″ Binder 3 2 **Coal** 4 3 } Upper Freeport ("Split-six," "Davis")	9	1	269	1
Fire clay, shaly, to bottom	1	11	271	0

Davis Coal & Coke Company No. 65 Coal Test Boring (81).

Union District; on Deakin Run of North Branch of Potomac River, 1 mile southwest of Henry; authority, Davis Coal & Coke Company; completed, October 24, 1914; elevation, 2715′ B.

	Thickness. Ft.	In.	Total. Ft.	In.
Clay and gravel	54	0	54	0
Shale, light	13	0	67	0
Fire clay	3	0	70	0
Shale, light	10	0	80	0
Sandstone, **Thomas**	52	0	132	0
Slate	1	0	133	0
Bone and **coal** 1′ 10″ **Coal** 0 5 Bone and **coal** 0 5 **Coal** 3 8 } Bakerstown ("Thomas")	6	4	139	4
Fire clay	13	8	153	0
Shale, sandy	4	0	157	0
Sandrock, hard, **Buffalo**	12	0	169	0
Shale, sandy	26	0	195	0
Slate, **Brush Creek**	10	0	205	0
Coal 0′ 4″ Slate 0 5 **Coal** 1 0 } **Brush Creek**	1	9	206	9
Fire clay	4	3	211	0
Shale and fire clay	26	0	237	0
Shale, variegated	25	0	262	0

	Thickness. Ft.	In.	Total. Ft.	In.
Shale, dark, sandy	14	0	276	0
Sandstone .. 4′ 0″ Shale, dark 15 0 } Upper Mahoning Sandstone .. 1 0	20	0	296	0
Slate	1	0	297	0
Coal ..... 1′ 2″ Fire clay .... 2 10 } Mahoning ("Six-foot") Coal 0 7	4	7	301	7
Fire clay	0	10	302	5
Shale, sandy	14	7	317	0
Sandstone ..... 1′ 0″ Shale and sandstone 12 0 } Lower Mahoning	13	0	330	0
Slate	1	0	331	0
Coal ..... 1′ 8″ Bone and coal 0 8 } Upper Freeport ("Split-six," "Davis") Coal 3 6	5	10	336	10
Fire clay, to bottom	2	2	339	0

Davis Coal & Coke Company No. 64 Coal Test Boring (82).

Union District; on Deakin Run of North Branch of Potomac River, 1.4 miles southwest of Henry; authority, Davis Coal & Coke Company; completed, October 24, 1914; elevation, 2780′ B.

	Thickness. Ft.	In.	Total. Ft.	In.
Clay and gravel	31	0	31	0
Shale, dark	14	0	45	0
Slate and fire clay	2	0	47	0
Coal, Harlem	0	2	47	2
Fire clay	10	0	57	2
Shale and fire clay	25	10	83	0
Sandstone, hard, Jane Lew	5	0	88	0
Fire clay	4	0	92	0
Shale, light	22	0	114	0
Fire clay	5	0	119	0
Slate	1	0	120	0
Sandstone, Thomas	53	0	173	0
Slate	2	0	175	0
Coal and slate 1′ 8″ Coal ..... 3 9 } Bakerstown ("Thomas")	5	5	180	5
Fire clay	12	7	193	0
Sandstone, hard, Buffalo	10	0	203	0
Shale, sandy	10	0	213	0
Fire clay	12	0	225	0
Shale, sandy	25	0	250	0
Slate, Brush Creek	10	0	260	0
Coal ..... 0′ 6″ Slate ..... 0 6 } Brush Creek Coal 0 4	1	4	261	4
Fire clay	4	8	266	0
Shale, sandy	11	0	277	0
Fire clay	13	0	290	0
Shale, sandy	18	0	308	0

	Thickness. Ft.	In.	Total. Ft.	In.
Sandstone	1	0	309	0
Slate	1	0	310	0
Coal and slate 0′ 6″ / Coal 1 6 — Mahoning ("Six-foot")	2	0	312	0
Fire clay	2	6	314	6
Shale, sandy	6	0	320	6
Sandstone	1	4	321	10
Shale, dark, sandy	12	2	334	0
Shale and sandstone	5	0	339	0
Slate	1	4	340	4
Coal	0	6	340	10
Slate	5	2	346	0
Shale and sandstone	2	0	348	0
Shale, sandy	8	0	356	0
Slate	1	0	357	0
Coal, Upper Freeport ("Split-six," "Davis")	0	2	357	2
Slate	3	5	360	7
Shale, sandy	12	0	372	7
Shale, variegated, with fire clay	6	0	378	7
Shale, variegated	11	5	390	0
Shale, variegated, with fire clay, to bottom	20	0	410	0

Davis Coal & Coke Company No. 70 Coal Test Boring (83).

Union District; on North Branch of Potomac River, 0.5 mile southwest of Henry; authority, Davis Coal & Coke Company; elevation, 2639′ L.

	Thickness. Ft.	In.	Total. Ft.	In.
Unrecorded	239	11	239	11
Bone	1	8	241	7
Coal, Bakerstown ("Thomas")	3	5	245	0
Unrecorded	178	3	423	3
Bone	1	8	424	11
Coal 1′ 0″ / Bone 1 0 / Coal 2 6 / Slate 0 1 / Coal, to bottom 1 6 — Upper Freeport ("Split-six," "Davis")	6	1	431	0

Davis Coal & Coke Company No. 67 Coal Test Boring (84).

Union District; on North Branch of Potomac River, 1 mile southwest of Henry; authority, Davis Coal & Coke Company; completed, October 24, 1914; elevation, 2670′ B.

	Thickness. Ft.	In.	Total. Ft.	In.
Clay and gravel	34	0	34	0
Shale, gray	12	0	46	0
Shale, red	2	6	48	6
Shale, green	8	6	57	0
Fire clay	5	0	62	0
Shale, gray	5	0	67	0

	Thickness. Ft.	In.	Total. Ft.	In.
Sandstone, hard, **Grafton**	6	0	73	0
Shale, hard, sandy	7	0	80	0
Shale, dark	10	0	90	0
Slate, black, **Ames**	11	6	101	6
Coal, Harlem	1	6	103	0
Fire clay	4	0	107	0
Fire clay, limy	15	0	122	0
Shale, red	8	0	130	0
Shale, gray, sandy	6	0	136	0
Sandstone, **Jane Lew**	2	0	138	0
Shale and clay	14	0	152	0
Shale, sandy	18	0	170	0
Lime and clay	6	0	176	0
Shale, red	4	0	180	0
Fire clay	6	0	186	0
Shale, flinty	7	0	193	0
Sandstone, hard, **Saltsburg**	28	0	221	0
Shale, dark	1	0	222	0
Sandstone, hard, **Thomas**	9	0	231	0
Shale, dark	2	0	233	0
Coal, Bakerstown ("Thomas")	5	0	238	0
Fire clay	4	0	242	0
Shale, gray, hard	14	0	256	0
Sandstone, hard, pebbly, **Buffalo**	18	0	274	0
Shale, light, sandy	15	0	289	0
Slate, black, **Brush Creek**	14	0	303	0
Slate and **coal, Brush Creek**	1	6	304	6
Shale, dark, hard	28	6	333	0
Fire clay	8	0	341	0
Shale, green	12	0	353	0
Shale, variegated, **Mahoning**	9	0	362	0
Lime and shale	9	0	371	0
Sandstone, hard.... 4′ 0″ Shale and slate.... 6 0 Sandstone ..... 4 0 } **Lower Mahoning**	14	0	385	0
Slate, black, **Uffington**	6	0	391	0
Coal ..... 0′ 1″ Slate ..... 3 5 **Coal** ..... 0 6 Slate ..... 4 0 **Coal** ..... 0 6 Slate ..... 1 0 **Coal** ..... 0 6 } **Upper Freeport ("Split-six," "Davis")**	10	0	401	0
Shale, dark	12	0	413	0
Shale, gray, sandy	10	6	423	6
Coal, Lower Freeport	4	0	427	6
Fire clay	1	6	429	0
Shale, dark	4	0	433	0
Slate, black, to bottom	7	0	440	0

The record of the **Davis Coal and Coke Company No. 62 Coal Test (No. 85 on Map IV)** has been published as the Wilsonia Section, pages 188-9. The seven following records are those of holes bored near the head of the Potomac, being located partly in Grant County and partly in Garrett County, Maryland:

Davis Coal & Coke Company No. 63 Coal Test Boring (86).

Union District; on a branch of North Branch of Potomac River, 0.3 mile south of Wilsonia; authority; Davis Coal & Coke Company; completed, March 12, 1913; elevation, 2757′ L.

	Thickness. Ft.	Thickness. In.	Total. Ft.	Total. In.
Clay and boulders	6	0	6	0
Sand and gravel	13	0	19	0
Sandstone, decomposed, and clay	5	0	24	0
Shale, soft, gray	4	0	28	0
Shale, gray	28	0	56	0
Sandstone, shaly 20′ 0″ Sandstone 15 0 } Jane Lew	35	0	91	0
Shale, dark	2	0	93	0
Shale, sticky, gray	6	0	99	0
Shale, dark	3	0	102	0
Shale, gray	20	0	122	0
Sandstone, hard, **Saltsburg**	8	0	130	0
Shale, soft	1	0	131	0
Shale, sandy	2	0	133	0
Shale, limy	11	0	144	0
Sandstone, hard, **Thomas**	6	3	150	3
Shale, dark	0	2	150	5
Coal, Bakerstown ("Thomas")	4	11	155	4
Shale, hard	1	8	157	0
Fire clay, flinty	6	0	163	0
Shale, gray	11	0	174	0
Shale, sandy	14	0	188	0
Shale, gray	5	0	193	0
Shale, sandy	13	0	206	0
Shale, blue, **Brush Creek**	20	6	226	6
Coal 0′ 5″ Shale 0 4 **Coal** 1 0 } **Brush Creek**	1	9	228	3
Shale, gray	5	9	234	0
Sandstone	4	0	238	0
Shale, hard, sandy	1	0	239	0
Shale, sandy	6	0	245	0
Shale, gray	7	0	252	0
Shale, sandy	15	0	267	0
Conglomerate, shale, and sandstone	16	0	283	0
Shale, gray	10	0	293	0
Shale, sandy	4	0	297	0
Shale, gray	3	0	300	0
Shale, sandy	9	0	309	0
Shale, dark	1	0	310	0
Bone coal	0	8	310	8
Slate	0	4	311	0
Sandstone, hard, **Upper Mahoning**	14	0	325	0
Shale, sandy	5	0	330	0
Shale, blue	10	0	340	0
Coal 0′ 2″ Slate 0 1 **Coal** 0 2 } **Mahoning ("Six-foot")**	0	5	340	5
Slate, gray, with **coal** partings	4	7	345	0

	Thickness. Ft.	In.	Total. Ft.	In.
Shale, sandy	13	0	358	0
Shale, dark, **Uffington**	4	5	362	5
Coal 1′ 11″ / Shale, dark 0 9 / **Coal** 0 8 / Shale, gray 17 8 / **Coal**, with 1″ shale parting 3 9 — **Upper Freeport ("Split-six," "Davis")**	24	9	387	2
Shale, dark	1	2	388	4
Fire clay	4	8	393	0
Shale, sandy	11	0	404	0
Sandstone 12′ 0″ / Shale, sandy 9 0 / Sandstone 1 0 — **Upper Freeport**	22	0	426	0
Shale, sandy	2	0	428	0
Sandstone, hard	1	0	429	0
Shale, sandy	4	0	433	0
Sandstone, hard, to bottom	2	0	435	0

Davis Coal & Coke Company No. 51 Coal Test Boring (87).

Union District; on branch of North Branch of Potomac River, 1.6 miles northeast of Fairfax; authority, Davis Coal & Coke Company; completed, April 7, 1913; elevation, 2868′ L.

	Thickness. Ft.	In.	Total. Ft.	In.
Clay and sand	5	0	5	0
Conglomerate	3	6	8	6
Clay and gravel	5	0	13	6
Boulders	1	6	15	0
Clay, yellow	4	0	19	0
Shale, soft, light	2	0	21	0
Sandstone	1	0	22	0
Shale, gray	5	0	27	0
Sandstone, hard	3	0	30	0
Shale, sandy	4	0	34	0
Shale, soft, gray	2	0	36	0
Sandstone 15′ 0″ / Sandstone, hard 4 6 — **Buffalo**	19	6	55	6
Coal, smutty, **Brush Creek**	1	3	56	9
Shale, soft, gray	15	3	72	0
Shale, limy	8	0	80	0
Shale, with sandstone	3	0	83	0
Shale	2	0	85	0
Sandstone, hard 2′ 0″ / Sandstone, shaly 6 0 / Sandstone 30 0 — **Upper Mahoning**	38	0	123	0
Shale, soft, dark	1	0	124	0
Shale, hard, sandy	12	0	136	0
Shale, limy	5	0	141	0

	Thickness. Ft.	In.	Total. Ft.	In.
Shale, soft, gray	16	0	157	0
Shale, sandy	3	0	160	0
Shale, dark	5	0	165	0
Shale, black	4	0	169	0
Shale, sticky, gray	1	0	170	0
Sandstone, **Lower Mahoning**	3	0	173	0
Shale, sandy..... 3′ 7″ Shale, black .... 1 0 } **Uffington**	4	7	177	7
Coal, Upper Freeport ("Davis," "Split-six")	4	3	181	10
Fire clay	6	2	188	0
Shale, gray, sticky	8	0	196	0
Shale, limy	8	0	204	0
Sandstone, hard, **Upper Freeport**	10	0	214	0
Shale, hard, sandy	10	0	224	0
Shale, dark, sticky	6	0	230	0
Shale, sandy	4	0	234	0
Shale, with sandstone bands	4	0	238	0
Shale, gray	12	0	250	0
Shale, dark	6	0	256	0
Slate	0	3	256	3
Bone coal 0′ 6″ **Coal** ..... 0 4 } **Upper Kittanning**	0	10	257	1
Shale, gray	1	11	259	0
Shale, with sandstone bands	9	0	268	0
Shale, limy	12	0	280	0
Shale, sandy	21	0	301	0
Sandstone, **East Lynn**	14	0	315	0
Shale, dark	17	0	332	0
Shale, sandy	8	0	340	0
Shale, dark	1	2	341	2
Coal ..... 0′ 4″ Slate ..... 0 5 **Bone coal**.... 0 10 } **Lower Kittanning**	1	7	342	9
Slate	0	2	342	11
Fire clay	0	8	343	7
Shale, with sandstone bands, **Homewood horizon**	18	0	361	7
Shale, sandy	3	0	364	7
Shale, dark	16	0	380	7
Shale, with **coal, Upper Mercer?**	5	0	385	7
Shale, dark	5	0	390	7
Fire clay, hard	20	0	410	7
Shale, with sandstone bands	10	0	420	7
Bone coal 2′ 0″ **Coal** ..... 0 9 Shale ..... 0 1½ **Coal** ..... 0 4½ } **Lower Merver (Stockton?)**	3	3	423	10
Shale, gray	1	9	425	7
Shale, black, and sulphur	0	6	426	1
Fire clay	5	6	431	7
Shale, sandy	5	0	436	7
Sandstone, to bottom, **Upper Connoquenessing?**	3	0	439	7

Davis Coal & Coke Company No. 61 Coal Test Boring (88).

Garrett County, Maryland; on North Branch of Potomac River, 0.9 mile northeast of Kempton; authority, Davis Coal & Coke Company; completed, January 7, 1913; elevation, 2699′ L.

	Thickness. Ft.	In.	Total. Ft.	In.
Sand and gravel	42	0	42	0
Shale, gray	19	0	61	0
Sandstone ..... 20′ 0″ Shale, gray ..... 5 0 } Grafton Sandstone, hard.... 4 0	29	0	90	0
Shale, gray	25	0	115	0
Coal, Harlem	0	8	115	8
Slate, dark ..... 5′ 4″ Shale, soft, muddy.... 20 0 Shale, blue ..... 7 0 } Pittsburgh Reds.. Shale, red ..... 5 0 Shale, blue 10 0	47	4	163	0
Sandstone, Jane Lew	19	0	182	0
Shale, blue.. 6′ 0″ Slate, red .... 2 0 Shale, blue.. 6 0 Shale, red.... 5 0 Shale, gray 22 0 } Pittsburgh Reds Shale, blue.. 2 0 Shale, red .. 2 0 Shale, blue.. 22 0	67	0	249	0
Sandstone, Saltsburg	15	0	264	0
Shale, blue	2	0	266	0
Shale, red	12	0	278	0
Shale, sandy	2	0	280	0
Limestone, shaly	18	0	298	0
Shale, blue	20	0	318	0
Shale, dark, Brush Creek	8	0	326	0
Slate, black, Brush Creek Coal horizon	16	0	342	0
Shale, gray	5	0	347	0
Shale, sandy	9	0	356	0
Sandstone, Upper Mahoning	27	0	383	0
Slate, Mahoning ("Six-foot") Coal horizon	3	0	386	0
Sandstone, Lower Mahoning	30	0	416	0
Slate, black .... 9′ 0″ Shale, dark .... 20 0 } Uffington Shale, gray 6 0	35	0	451	0
Slate, black, Upper Freeport ("Split-six," "Davis") Coal horizon	10	0	461	0
Slate, gray	19	0	480	0
Shale, soft	21	0	501	0
Shale, dark	18	0	519	0
Shale, gray	14	0	533	0
Shale, dark, Upper Kittanning Coal horizon, to bottom	7	0	540	0

Davis Coal & Coke Company No. 60 Coal Test Boring (89).

Garrett County, Maryland; on North Branch of Potomac River, 0.6 mile northeast of Kempton; authority, Davis Coal & Coke Company; elevation, 2707' L.

	Thickness. Ft.	In.	Total. Ft.	In.
Clay, yellow	20	0	20	0
Fire clay, soft	15	0	35	0
Shale, gray, sandy	30	0	65	0
Fire clay, soft	3	0	68	0
Shale, gray, sandy	27	0	95	0
Slate, black, **Harlem Coal horizon**	15	0	110	0
Fire clay, soft	5	6	115	6
Shale, gray	20	0	135	6
Shale, red	10	6	146	0
Limestone	14	0	160	0
Shale, gray	3	0	163	0
Limestone	17	0	180	0
Shale, sandy	16	0	196	0
Sandstone, **Saltsburg**	46	0	242	0
Slate	5	0	247	0
Coal, Bakerstown ("Thomas")	0	2	247	2
Slate	5	6	252	8
Sandstone, **Buffalo**	20	10	273	6
Shale, sandy	23	6	297	0
Shale, red	10	0	307	0
Shale, sandy	9	0	316	0
Slate, black	11	0	327	0
Limestone	4	0	331	0
Shale, soft	20	0	351	0
Fire clay	7	0	358	0
Shale, sandy	24	0	382	0
Sandstone .. 12' 0" Clay, soft .. 2 0 } **Lower Mahoning** Sandstone .. 23 0	37	0	419	0
Slate, black, **Upper Freeport ("Split-six," "Davis") Coal horizon?**	7	0	426	0
Slate	6	0	432	0
Shale, sandy	11	0	443	0
Clay, hard, **Bolivar**	3	0	446	0
Shale, sandy, to bottom	41	0	487	0

Davis Coal & Coke Company No. 59 Coal Test Boring (90).

Garrett County, Maryland; on a branch of North Branch of Potomac River, 0.5 mile northeast of Kempton; authority, Davis Coal & Coke Company; completed, December 6, 1912; elevation, 2710' L.

	Thickness. Ft.	In.	Total. Ft.	In.
Clay and boulders	17	0	17	0
Sandstone, **Morgantown**	46	0	63	0
Shale, limy	15	0	78	0
Slate, gray	11	0	89	0
Slate, blue	8	0	97	0
Coal, Elk Lick ("Barton," "Four-foot"?)	1	0	98	0

	Thickness. Ft.	In.	Total. Ft.	In.
Shale, hard, blue	10	0	108	0
Shale, broken, limy	20	0	128	0
Shale, sandy	5	0	133	0
Limestone	20	0	153	0
Shale, broken	15	0	168	0
Shale, black	2	0	170	0
Shale, gray	3	0	173	0
Bone coal, Harlem	1	0	174	0
Shale, broken 6′ 0″				
Shale, limy 69 0				
Shale, red 3 0 — **Pittsburgh Reds**	92	0	266	0
Shale, gray 11 0				
Shale, red 3 0				
Shale, gray	34	0	300	0
Shale, black	5	0	305	0
Slate, black	0	2	305	2
Coal, Bakerstown ("Thomas")	0	10	306	0
Shale, sandy	8	0	314	0
Shale, blue	9	0	323	0
Shale, gray	7	0	330	0
Shale, blue	28	0	358	0
Sandstone, coarse 9′ 0″				
Lime rock, hard 6 0				
Sandstone, very hard 11 0 — **Buffalo**	39	0	397	0
Sandstone, hard 13 0				
Shale, dark, **Brush Creek**	5	0	402	0
Slate, gray	9	0	411	0
Slate, black, **Brush Creek Coal horizon**	1	0	412	0
Fire clay	1	0	413	0
Shale, gray	28	0	441	0
Shale, colored	17	0	458	0
Shale, gray	24	0	482	0
Coal, Upper Freeport ("Davis," "Split-six")	2	0	484	0
Shale, muddy	19	0	503	0
Shale, soft, dark, to bottom	15	0	518	0

Davis Coal & Coke Company No. 50 Coal Test Boring (91).

Union District; on branch of North Branch of Potomac River, 0.3 mile east of Fairfax; authority, Davis Coal & Coke Company; completed, April 7, 1913; elevation, 2814′ L.

	Thickness. Ft.	In.	Total. Ft.	In.
Clay and boulders	15	0	15	0
Slate	5	0	20	0
Sandstone, **Grafton**	10	0	30	0
Shale, gray	20	0	50	0
Slate, gray	6	0	56	0
Coal, Harlem	1	0	57	0
Shale, gray	3	0	60	0
Shale, soft, broken, gray	41	0	101	0
Sandstone, white, **Saltsburg**	29	0	130	0
Shale, broken, gray	19	0	149	0
Shale, gray	30	0	179	0
Shale, broken, gray	34	0	213	0

	Thickness. Ft.	In.	Total. Ft.	In.
Shale, gray	25	0	238	0
Shale, red	4	0	242	0
Shale, blue, sandy	10	0	252	0
Shale, gray	16	0	268	0
Slate, dark, Brush Creek	5	0	273	0
Coal 0′ 4″ / Binder 0 4 / Coal 1 10 } Brush Creek	2	6	275	6
Shale, broken, gray	17	6	293	0
Shale, gray	28	0	321	0
Sandstone 49′ 0″ / Sandstone, hard, gray 8 0 } Upper Mahoning	57	0	378	0
Slate, black	15	0	393	0
Coal, Upper Freeport ("Davis," "Split-six")	0	8	393	8
Slate, black	1	4	395	0
Shale, dark, sandy	10	0	405	0
Shale, gray	10	0	415	0
Shale, soft, muddy	7	0	422	0
Slate, black	31	0	453	0
Shale, dark, sandy, with coal bands, Upper Kittanning	12	0	465	0
Shale, sandy	3	0	468	0
Sandstone, hard, East Lynn	38	0	506	0
Shale, gray	10	0	516	0
Slate, black	5	6	521	6
Coal 0′ 6″ / Slate 0 1 / Coal 0 6 } Lower Kittanning	1	1	522	7
Fire clay, hard	8	6	531	1
Shale, gray	10	0	541	1
Shale, dark	14	0	555	1
Bone coal, Clarion	0	10	555	11
Shale, gray	17	2	573	1
Slate, gray	1	6	574	7
Coal	0	2	574	9
Slate, gray	17	4	592	1
Shale, dark	10	0	602	1
Slate, dark	18	0	620	1
Shale, dark	20	0	640	1
Shale, dark, sandy	9	0	649	1
Conglomerate, Upper Connoquenessing, to bottom	15	0	664	1

Davis Coal & Coke Company No. 49 Coal Test Boring (92).

Union District; on branch of North Branch of Potomac River, 0.2 mile northeast of Fairfax; authority, Davis Coal & Coke Company; completed, March 11, 1913; elevation, 2967′ L.

	Thickness. Ft.	In.	Total. Ft.	In.
Clay and boulders	6	0	6	0
Gravel and boulders	20	0	26	0
Shale, blue	5	0	31	0

	Thickness. Ft.	In.	Total. Ft.	In.
Shale, muddy	14	0	45	0
Shale, red	10	0	55	0
Shale, gray	42	0	97	0
Shale, red	12	0	109	0
Shale, gray	34	0	143	0
Shale, red	3	0	146	0
Shale, gray	13	0	159	0
Shale, red	10	0	169	0
Shale, gray, broken	10	0	179	0
Shale, dark	8	0	187	0
Shale, gray	49	0	236	0
Shale, red	19	0	255	0
Shale, gray	30	0	285	0
Slate, dark, **Ames**	2	6	287	6
Coal, Harlem	1	6	289	0
Shale, gray	25	0	314	0
Shale, sandy	9	0	323	0
Shale, blue	20	0	343	0
Sandstone, **Jane Lew**	9	0	352	0
Shale, gray	15	0	367	0
Shale, red	3	0	370	0
Shale, gray, muddy	11	0	381	0
Shale, gray	10	0	391	0
Sandstone, **Thomas**	6	0	397	0
Shale, dark, **Bakerstown ("Thomas") Coal horizon**	10	0	407	0
Shale, soft, gray	53	0	460	0
Shale, red	10	0	470	0
Shale, sandy	17	0	487	0
Slate, dark, **Brush Creek**	14	0	501	0
Coal, Brush Creek	1	0	502	0
Shale, gray	24	0	526	0
Shale, blue	10	0	536	0
Shale, gray	26	0	562	0
Sandstone, **Upper Mahoning**	17	0	579	0
Shale, soft, gray	10	0	589	0
Slate, black	1	0	590	0
Bone coal, Mahoning ("Six-foot")	0	6	590	6
Slate, black	1	6	592	0
Sandstone, dark, **Lower Mahoning**	25	0	617	0
Slate, **Uffington**	3	6½	620	6½
Coal ..... 0′ 8″ Slate .... 1 9 **Coal** ..... 4 11 } **Upper Freeport ("Davis" "Split-six")**	7	4	627	10½
Slate	1	9	629	7½
Fire clay	3	4½	633	0
Flint clay, hard, to bottom	6	4	639	4

The record of the **Davis Coal and Coke Company No. 48 Coal Test (No. 93 on Map IV)** has been published as a part of the Fairfax Section, pages 190-2. The two following records are those of holes in the vicinity of Kempton, Garrett County, Maryland:

Davis Coal & Coke Company No. 47 Coal Test Boring (94).

Garrett County, Maryland; on North Branch of Potomac River at Kempton shaft; authority, Davis Coal & Coke Company; completed, December 19, 1911; elevation, 2712′ L.

	Thickness.		Total.	
	Ft.	In.	Ft.	In.
Clay and boulders	17	8	17	8
Sandstone, coarse, brown 3′ 4″ Sandstone, shaly 10 0 Sandstone 1 6 Sandstone, shaly 3 6 } Grafton	18	4	36	0
Shale, gray	16	0	52	0
Shale, dark, **Ames**	11	10	63	10
Bony coal, Harlem	1	4	65	2
Shale, gray, sticky	16	10	82	0
Shale, red and gray	4	0	86	0
Shale, gray, sticky	12	0	98	0
Shale, limy	2	0	100	0
Shale, gray	5	0	105	0
Shale, red	7	0	112	0
Shale, gray	4	0	116	0
Shale, blue	11	0	127	0
Shale, blue, sandy	14	0	141	0
Limestone	9	0	150	0
Shale, dark-gray	4	0	154	0
Sandstone, blue, **Saltsburg**	6	0	160	0
Shale, gray	15	0	175	0
Shale, dark, **Bakerstown** ("Thomas") **Coal horizon**	17	0	192	0
Limestone, **Albright**	1	6	193	6
Shale, blue, sandy	14	6	208	0
Shale, blue, sandy, with limestone, **Pine Creek**	5	0	213	0
Shale, black	0	8	213	8
Shale, sticky, gray	3	4	217	0
Shale, blue	20	0	237	0
Sandstone, **Buffalo**	12	0	249	0
Shale, gray	4	0	253	0
Shale, blue, sandy	16	0	269	0
Shale, black, **Brush Creek**	12	2	281	2
Coal, Brush Creek	1	2	282	4
Fire clay, dark	0	8	283	0
Shale, dark, soft, gray	8	0	291	0
Shale, blue, sandy	18	0	309	0
Sandstone, hard, **Upper Mahoning**	19	0	328	0
Shale, gray	6	0	334	0
Shale, blue, sandy	7	0	341	0
Sandstone, coarse 19′ 0″ Sandstone, very hard 3 0 Sandstone, fine-grained, hard 16 0 Sandstone, hard 8 0 Sandstone, shaly 4 0 } Lower Mahoning	50	0	391	0
Shale, gray	5	0	396	0
Shale, sandy	2	0	398	0
Sandstone, fine-grained	2	2	400	2

	Thickness. Ft.	In.	Total. Ft.	In.
Coal ..... 1′ 4″ Binder ..... 0 1 Coal ..... 3 1 Slate, dark 1 10 Coal ..... 1 5 Binder ..... 0 1 Coal ..... 2 0 — Upper Freeport ("Davis," "Split-six")	9	10	410	0
Shale, gray, to bottom	6	0	416	0

Davis Coal & Coke Company No. 45 Coal Test Boring (95).

Garrett County, Maryland; on North Branch of Potomac River, 0.4 mile west of Kempton; authority, Davis Coal and Coke Company; completed, January 6, 1912; elevation, 2727′ L.

	Thickness. Ft.	In.	Total. Ft.	In.
Clay and boulders	6	0	6	0
Shale, soft	3	0	9	0
Shale, sandy	12	0	21	0
Shale, blue, sandy	22	0	43	0
Shale, soft, dark	4	0	47	0
Limestone, **Ewing**	6	0	53	0
Shale, red	2	0	55	0
Shale, blue, sandy	25	0	80	0
Sandstone, **Saltsburg**	12	0	92	0
Shale, dark, **Bakerstown** ("Thomas") **Coal horizon**	8	0	100	0
Shale, gray, with limestone, **Albright**	4	0	104	0
Shale, blue	43	0	147	0
Sandstone, **Buffalo**	9	0	156	0
Shale, red	7	0	163	0
Shale, blue	17	0	180	0
Shale, dark, **Brush Creek**	11	4	191	4
Bone coal, Brush Creek	1	8	193	0
Shale, gray	7	0	200	0
Sandstone ..... 4′ 0″ Shale, gray, sandy 24 0 Sandstone ..... 9 0 — Upper Mahoning	37	0	237	0
Shale, blue	7	0	244	0
Shale, gray, mixed with lime	22	0	266	0
Sandstone, hard.. 2′ 0″ Sandstone ..... 10 0 — Lower Mahoning	12	0	278	0
Shale, gray, sandy	11	0	289	0
Shale, dark.. 4′ 0″ Shale, gray.. 4 0 Shale, dark.. 3 0 — Uffington	11	0	300	0
Shale, dark, with **coal partings**	1	9	301	9
Coal ..... 1′ 2″ Shale, dark 4 11 Coal ..... 2 7½ Slate binder 0 2½ Coal ..... 3 1 Slate binder 1 3 Coal ..... 4 7 — Upper Freeport ("Davis," "Split-six")	17	10	319	7
Shale, gray, to bottom	5	0	324	7

The records of two borings (**Nos. 96 and 97 on Map IV**), located in the southwestern corner of Preston County and west of Kempton, have been published in the Preston County Report of the Survey, with the Upper Freeport Coal erroneously named as the "Middle and Lower Kittanning," and they have been later published in the Tucker County Report with the nomenclature of the coals and other members revised. An outline of the coals found in them is published in the Table of Summarized Coal Test Records, page 479 of this Report. In the same table, also will be found the abbreviated records of Nos. 98, 99, 102, 103, and 106-116, inclusive, their positions, as indicated on Map IV, being in Fairfax District, Tucker County, and their detailed records having been published in the Survey Report on that County.

MINABLE COALS OF THE MONONGAHELA SERIES.

SEWICKLEY ("TYSON") COAL.

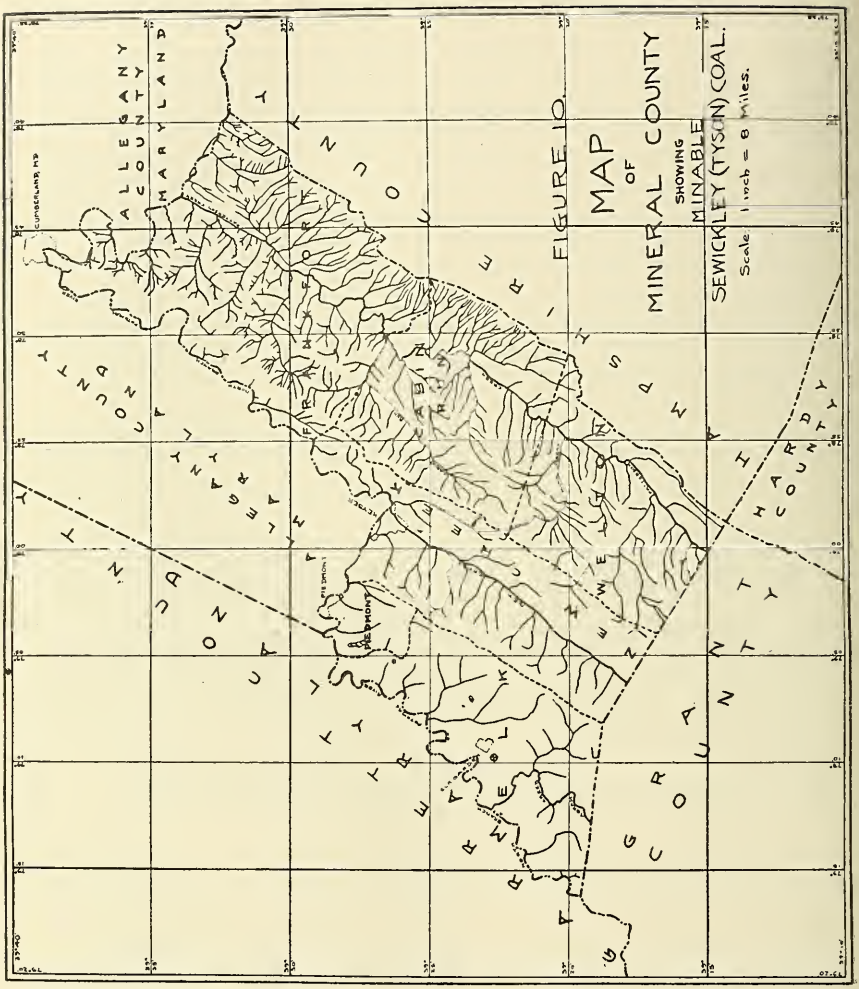
The Sewickley ("Tyson") Coal, previously described in Chapter VI, page 199, and shown by outcrop lines on Map II, occurs only in a few high ridges in Mineral County, there being a small body of it in Piedmont District, southwest of Piedmont, and another in Elk District, south of Elk Garden. Figure 10 shows its areal extent. It has been mined commercially and much of the original tonnage has been removed.

Sewickley ("Tyson") Coal, Piedmont District, Mineral County.

In Piedmont District, Mineral County, the Sewickley Coal is found only in a high ridge lying between Montgomery and Piney Swamp Runs. As indicated in the Piedmont Section, page 155, it was once opened at the **Silver Coal Company Prospect (No. 1 on Map II)** near the top of the ridge west of Montgomery Run and 1.1 miles southwest of West Virginia Central Junction, its elevation being 2105′ B. No information as to its thickness was obtained.

Sewickley ("Tyson") Coal, Elk District, Mineral County.

In Elk District, Mineral County, the Sewickley Coal has been mined in the high ridge just southwest of Elk Garden. A large amount of the original coal has already been removed but the following section was obtained 50 feet under cover at a new opening:


ALLEGANY COUNTY
MARYLAND
GARRETT COUNTY
PRESTON COUNTY
TUCKER COUNTY
RANDOLPH COUNTY
BARBOUR COUNTY
UPSHUR COUNTY
LEWIS COUNTY
HARRISON COUNTY
TAYLOR COUNTY
MONONGALIA COUNTY
MARION COUNTY
WETZEL COUNTY
MARSHALL COUNTY
TYLER COUNTY
PLEASANTS COUNTY
WOOD COUNTY
RITCHIE COUNTY
DODDRIDGE COUNTY
CUMBERLAND MD.
FIGURE 10.
MAP
OF
MINERAL COUNTY
SHOWING
MINABLE
SEWICKLEY (TYSON) COAL.
Scale 1 inch = 8 miles.

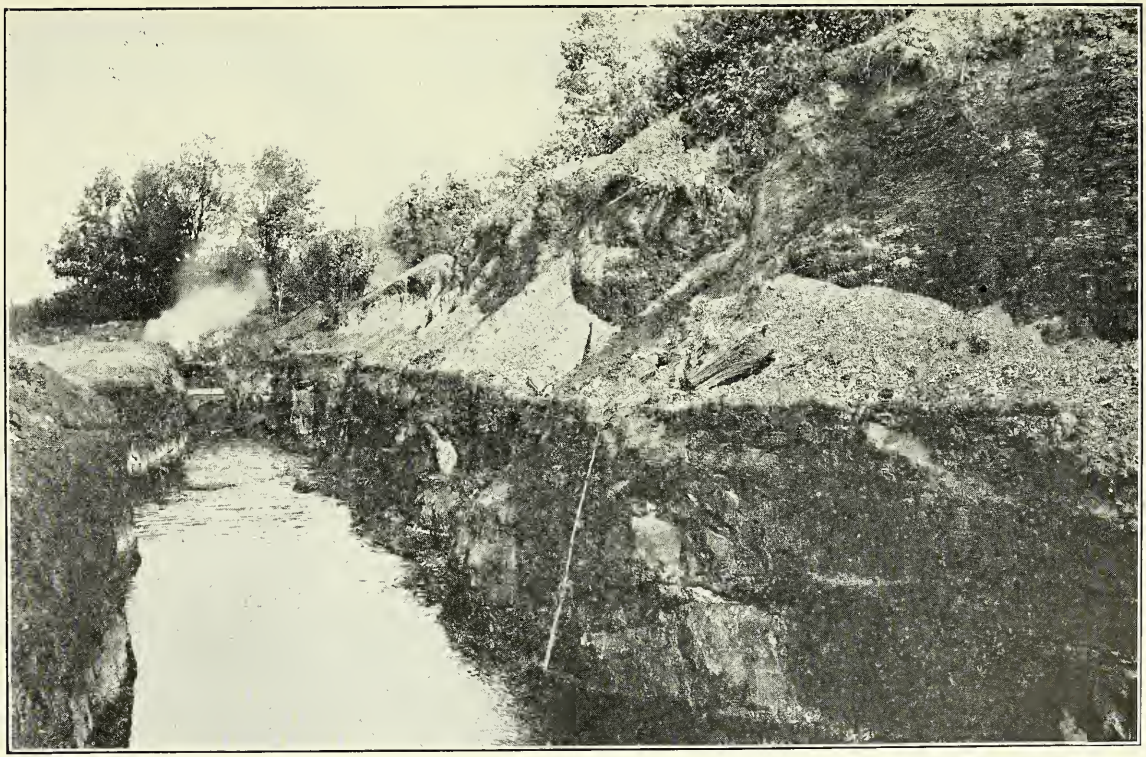


Photo by E. E. HARRIS.

PLATE XXVIII.—Pittsburgh ("Big Vein") Coal at stripping plant of Smith Big Vein Coal Company (Mine No. 25 on Map II) northwest of Sulphur City. Several feet of coal are concealed by water.

Dean Coal Company No. 4 Mine (Tyson Opening) No. 2 on Map II.

On waters of Deep Run, 0.3 mile southwest of Elk Garden; **Sewickley Coal**; elevation, 2440′ B.; section measured 50′ in, at face.

			Ft.	In.
1. Sandstone, massive, **Sewickley**				
2. Shale, gray			0	8
3. **Coal**	5′	1″		
4. Shale, dark	0	3		
5. **Coal**	0	5	5	9
6. Shale, pavement				

A sample (No. 508R) was collected from Nos. 3 and 5 of section, the composition of which is published under **Mine No. 2** in the Table of Coal Analyses at the end of this Chapter. The analysis shows a high percentage of moisture, reflected also in the oxygen content of the ultimate analysis, due largely to the lack of cover and nearness to outcrop. It is much to be regretted that a more representative sample could not be obtained.

The blossom of this coal is also visible at **Exposure No. 3 on Map II** along the public road in the southeastern part of the same ridge, 0.4 mile southwest of Elk Garden, at an elevation of 2440′ B.

Quantity of Sewickley ("Tyson") Coal Available.

The following table, compiled by Tucker from a planimetric measurement of the outcrop on Map II, shows the probable amount of Sewickley Coal existing in Mineral County before mining operations began:

Probable Amount of Sewickley ("Tyson") Coal.

Districts.	Thickness of Coal Assumed. Feet.	Square Miles.	Acres.	Cubic Feet of Coal.	Short Tons of Coal.
Mineral County:					
Piedmont	5	0.200	128.0	27,878,400	1,115,136
Elk	5	0.135	86.4	18,817,920	752,717
Totals		0.335	214.4	46,696,320	1,867,853

In the above table an allowance has been made for impurities and local thinning but none has been made for the coal already mined, exact figures not being available. It does not appear probable that more than five per cent. of the original acreage remains undisturbed, so that the total area would be reduced to 10.7 acres, or approximately 93,218 short tons.

REDSTONE COAL.

The Redstone Coal, previously described in Chapter VI, page 200, occurs in some of the high ridges along the North Potomac and Stony River Synclines in Mineral County, but is not found in Grant, its horizon being above the topography in that county. So far as observed no attempt has been made to mine this coal, either for domestic fuel or for commercial shipment, its presence having apparently been disregarded on account of the thicker Sewickley and Pittsburgh Coals lying above and below it, respectively. Although no prospects have been made its visible outcrops are of sufficient thickness to warrant the belief that it is of minable thickness, but there is grave doubt whether any large percentage of its tonnage can now be recovered, after the thick Pittsburgh has already been removed from underneath it. Its outcrop is not delineated on Map II but its position is from 65 to 75 feet below the Sewickley and from 50 to 65 feet above the base of the Pittsburgh Coal so that there should be little difficulty in finding its horizon. Figure 11 indicates its various areas, together with its approximate extent.

Redstone Coal, Piedmont District, Mineral County.

In Piedmont District the Redstone Coal occurs only in the high ridge between Montgomery and Piney Swamp Runs. No prospect nor full exposure was noted in this locality but at the **Silver Coal Company Exposure (No. 4 on Map II)**, in the ridge west of Montgomery Run and 0.8 mile south of Hampshire, its blossom is visible at an elevation of 2060′ B.

Redstone Coal, Elk District, Mineral County.

In Elk District the Redstone Coal horizon belongs in portions of the high ridge west of Piney Swamp Run, in a high point east of Nethken and in several hillocks in the vicinity of Elk Garden, and possibly also in the tops of one or two other isolated hills. Its outcrop was noted only at **Coal Exposure No. 5 on Map II,** in the road 0.4 mile south of Elk Garden at an elevation of 2370′ B. Here it measures 4′ 0″ thick without any apparent partings, its position with re-

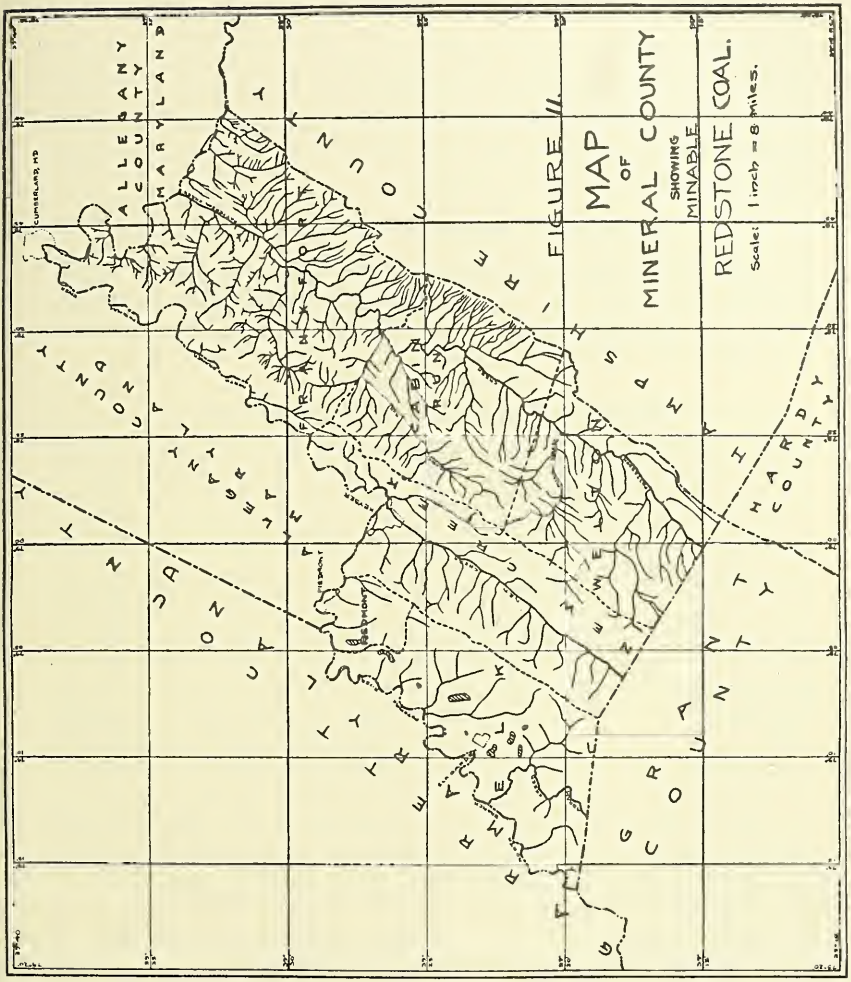


FIGURE II.
MAP
OF
MINERAL COUNTY
SHOWING
MINABLE
REDSTONE COAL.
Scale: 1 inch = 8 miles.
ALLEGANY
COUNTY
MARYLAND
GARRETT
COUNTY
PRESTON
COUNTY
TUCKER
COUNTY
RANDOLPH
COUNTY
GRANT
COUNTY
HARDY
COUNTY
HAMPSHIRE
COUNTY
CUMBERLAND, MD
KEYSER
PIEDMONT
ELK GARDEN
BAYARD
WILEY FORD
FORT ASHBY
NEW CREEK
CAPON BRIDGE
ROMNEY
SPRINGFIELD
PATTERSON CREEK
MOUNTAIN
NORTH BRANCH
POTOMAC
SOUTH BRANCH
POTOMAC

spect to the Sewickley and Pittsburgh beds being indicated in the Elk Garden Section, page 168. This exposure was too much weathered to get a representative sample for chemical analysis but the fact that this seam in every known region of its occurrence in the more western counties is a good, pure coal is strong evidence for the belief that the same quality is preserved in Mineral County.

Quantity of Redstone Coal Available.

The following table, compiled by Tucker from an interpolation between the Sewickley and Pittsburgh outcrops, gives the probable amount of Redstone Coal in Mineral County:

Probable Amount of Redstone Coal.

Districts.	Thickness of Coal Assumed. Feet.	Square Miles.	Acres.	Cubic Feet of Coal.	Short Tons of Coal.
Mineral County:					
Piedmont	3	0.27	172.8	22,581,504	903,260
Elk	3	1.25	800.0	104,544,000	4,181,760
Totals		1.52	972.8	127,125,504	5,085,020

As previously stated there is much doubt whether the major portion of this coal can now be recovered, the Pittsburgh having been almost completely mined out below it. If half of its tonnage remains in place where it can be reached by drifts there would be available 2,542,510 short tons.

PITTSBURGH ("BIG VEIN") COAL.

The Pittsburgh Coal, often called the "Big Vein" by the miners, and previously described in Chapter VI, page 201, occurs in several high ridges along the North Potomac and Stony River Synclines in Mineral County and in two isolated spots along the former basin in the vicinity of Fairfax, Grant County. Owing to its great thickness, there being sections of 10 to 15 feet now exposed and other abandoned workings reported as having measured more than 20 feet, and to its exceptional purity and the ease with which it could be mined,

it has been so intensively exploited that little solid coal of the original 2,000 odd acres in the two counties now remains. It is still being mined at a few drift openings and at stripping plants in Mineral County, mostly in pillars, where some good coal is found, and in outcropping edges of the seam, where oxidation in some localities is far advanced. Being low in both sulphur and ash as well as so extremely low in volatile matter that it is practically smokeless, this coal has for many years had an enviable reputation in the eastern markets as smithing and steam coal. Its outcrop is shown in detail on Maps II and IV, and Figures 12 and 13, respectively, indicate its approximate areal extent.

Pittsburgh ("Big Vein") Coal, Piedmont District, Mineral County.

In Piedmont District the Pittsburgh Coal has been found in minable quantity only in the high ridge between Montgomery and Piney Swamp Runs. East of Montgomery Run it has not been mined but a slight outcrop of disintegrated material is reported on a point 1½ miles southwest of Piedmont. The coal has been mined for many years at one plant on the western side of the run but the mouth of this opening had fallen completely shut at the time of the writer's visit in 1921. On the Maryland side of the Potomac, along the North Potomac (Georges Creek) Syncline which crosses the river at the mouth of Stony River and thence passes up the Georges Creek Valley, there is a larger acreage of the coal and several active mines.

In the Luke Section, page 158, apparently the full section of the coal is recorded at **Mine No. 6 on Map II,** located on Franklin Hill, Garrett County, Maryland, 1.3 miles northwest of the mouth of Georges Creek, at an elevation of 1885′ B. Here it measures 11′ 7″ with a considerable shale parting.

On the West Virginia side of the river the following partial section of the coal is exposed at a prospect opening, neither the top nor bottom shales being certainly visible:

Silver Coal Company Prospect—No. 7 on Map II.

On west side of Montgomery Run, 0.9 mile southwest of West Virginia Central Junction; **Pittsburgh Coal**; elevation, 2025′ B.

			Ft.	In.
Coal	6′	0″		
Slate, dark	0	3		
Coal	2	6	8	9
Slate, black				

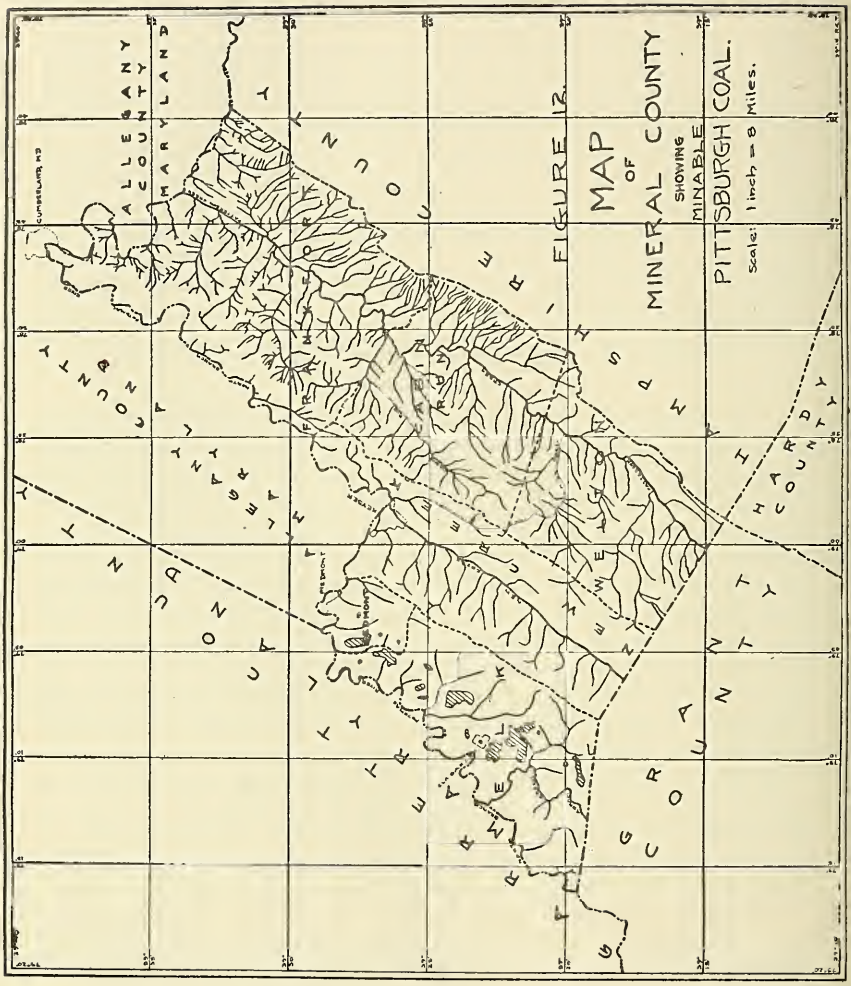


FIGURE 12.
MAP
OF
MINERAL COUNTY
SHOWING
MINABLE
PITTSBURGH COAL.
Scale: 1 inch = 8 miles.
ALLEGANY COUNTY
MARYLAND
GARRETT COUNTY
PRESTON COUNTY
TUCKER COUNTY
RANDOLPH COUNTY
BARBOUR COUNTY
UPSHUR COUNTY
HARRISON COUNTY
MONONGALIA COUNTY
MARION COUNTY
TAYLOR COUNTY
WESTON
CLARKSBURG
FAIRMONT
GRAFTON
CUMBERLAND MD

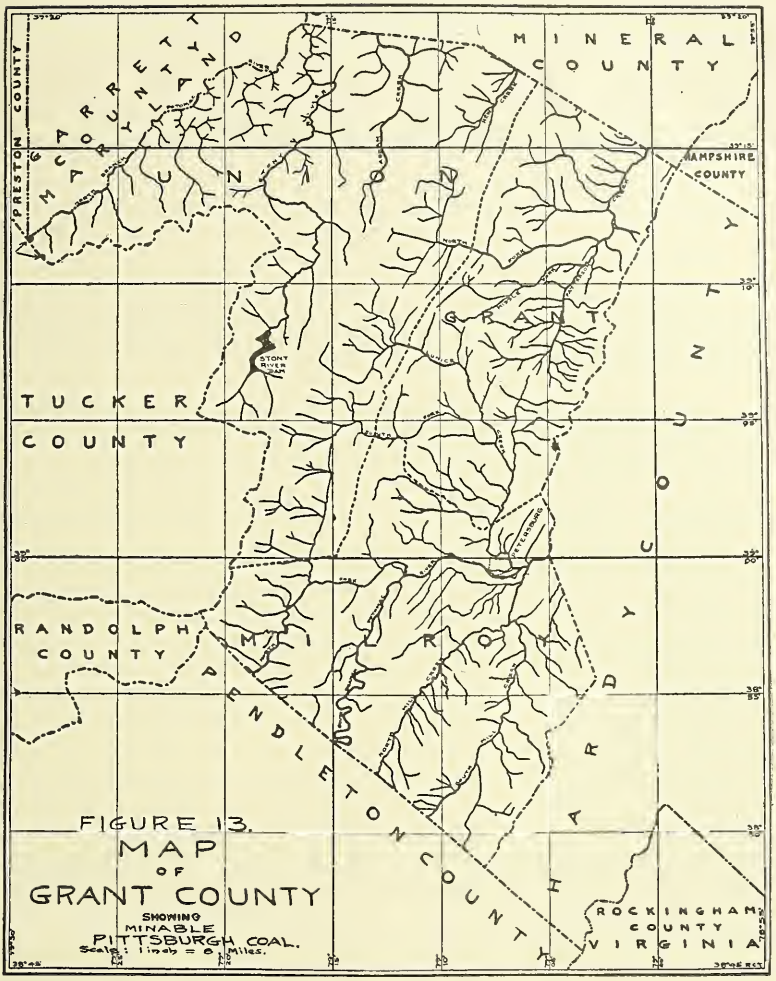


FIGURE 13.

MAP OF GRANT COUNTY SHOWING MINABLE PITTSBURGH COAL.

Scale: 1 inch = 6 miles.

The following mine had caved in at the mouth so that neither a detailed section nor a sample of the coal could be secured but some other data of interest were obtained at the company office:

Silver Coal Company No. 4 Mine—No. 8 on Map II.

On west side of Montgomery Run, 0.9 mile southwest of West Virginia Central Junction; **Pittsburgh Coal**; elevation, 2037′ B.

	Ft.	In.
Coal, with partings, fallen shut, reported	12	0

"Principal office, Luke, Md.; daily capacity, 50 tons; 8 miners and 3 laborers employed; horse haulage; coal shipped east for steam and domestic fuel; greatest rise, southeast; Lewis Grant, Superintendent, authority for mine data and thickness."

The above mine was formerly known as the **Davis Coal and Coke Company No. 11**, the operations of this pioneer corporation along the valley being of historic interest.

Pittsburgh ("Big Vein") Coal, Elk District, Mineral County.

In Elk District there are more abundant outcrops of the Pittsburgh and a few mining operations which are still active so that better information on the nature of the coal could be secured. At **Coal Prospect No. 9 on Map II**, located in a high, isolated point on the west side of Piney Swamp Run and 1 mile southwest of Hampshire at an elevation of 1890′ B., and attempt was made to mine the coal but for some unknown reason appears to have been abandoned. As shown by the Hampshire Section, page 163, the knob is capped by the Sewickley Sandstone, its top being 110 feet above the level of the prospect.

The two following openings have been made in recent years to remove old stumps left at the former **Davis Coal & Coke Company No. 10 Mine** in the ridge southwest of Windom, and afford somewhat incomplete sections of the coal:

Virginia Big Vein Coal Company Mine (North Opening)—No. 10 on Map II.

On east side of North Branch of Potomac River, 1 mile southeast of Windom; **Pittsburgh Coal**; elevation, 1950′ B.

			Ft.	In.
Shale, sandy				
Coal	8′	8″		
Shale, dark	0	4		
Coal	1	0	10	0
Concealed				

Virginia Big Vein Coal Company Mine (South Opening)—No. 11 on Map II.

On east side of North Branch of Potomac River, 1.2 miles southeast of Barnum; **Pittsburgh Coal**; elevation, 1970′ B.

			Ft.	In.
1. **Coal**, roof				
2. **Coal**	7′	6″		
3. Slate, gray	0	2		
4. **Coal**	2	9	10	5
5. Shale, pavement (?)				

A sample (No. 468R) was collected from Nos. 2 and 4 of section, the composition of which is published under **Mine No. 11** in the Table of Coal Analyses at the end of this Chapter.

The two following exposures were obtained at comparatively new stripping operations in the top of Shores Knob due east of Shaw, where the shale and soft sandstone cover was removed by steam shovel to get rapid and complete recovery. There is still some coal left in the knob, although the shovel has been removed and the mine, for the present at least, has been abandoned:

H. P. Brydon and Bro., Inc., Mine—No. 12 on Map II.

On north end of Shores Knob, 1.8 miles east of Shaw; **Pittsburgh Coal**; elevation, 2270′ B.

			Ft.	In.
1. Sandstone, shaly, **Pittsburgh**			10	0
2. Shale, sandy			10	0
3. **Coal**	9′	6″		
4. Shale, gray	0	4		
5. **Coal**	3	4	13	2
6. Shale, dark				

A sample (No. 471R) was collected from Nos. 3 and 5 of section, the composition of which is published under **Mine No. 12** in the Table of Coal Analyses at the end of this Chapter. The above sample was analyzed "As received" and on a "Moisture-free" basis, the latter showing plainly that the effect of oxidation is not wholly removed by drying out the coal, a part of the carbon being rendered inert by chemically combined oxygen which can not be removed by drying.

On the west side of the knob a very interesting interlamination of coal and sandstone which probably represents the Pittsburgh "Rider" Coal occurs above the main Pittsburgh section, as shown by the following data:

H. P. Brydon and Bro., Inc., Mine—No. 13 on Map II.

On west side of Shores Knob, 1.8 miles east of Shaw; **Pittsburgh Coal**; elevation, 2280′ B.

			Ft.	In.
1. Shale, sandy			10	0
2. **Coal**, with numerous sandy lenses, **Pittsburgh "Rider"**			8	6
3. Sandstone, massive			5	0
4. Shale, sandy			5	0
5. **Coal**	9′	6″		
6. Shale, gray	0	4		
7. **Coal**	3	4	13	2
8. Shale, dark				

The following exposure, showing neither the top nor the bottom of the coal, is located on the northeastern side of an isolated knob northeast of Shaw and along the winding haulage way from Shores Knob to the top of the plane where the coal was formerly eased down to the Western Maryland grade:

Coal Prospect—No. 14 on Map II.

On west side of a branch of Lynnwood Run, 1 mile northeast of Shaw; **Pittsburgh Coal**; elevation, 2000′ B.

			Ft.	In.
Coal	2′	9″		
Slate, dark	0	3		
Coal	3	8	6	8

Coal Exposure No. 15 on Map II is an abandoned outcrop of the coal at the southern end of the knob above named, on the north side of a branch of Howell Run, 0.9 mile east of Shaw at an elevation of 2075′ B.

At the following opening the coal has recently been mined by stripping, there being some tonnage still available in the knob, which lies east of Nethken:

Deep Run Big Vein Coal Company Mine—No. 16 on Map II.

On the east side of Deep Run, 0.7 mile east of Nethken; **Pittsburgh Coal**; elevation, 2300′ B.

			Ft.	In.
1. Shale, sandy			15	0
2. Slate, black, cannelly			2	0
3. Shale, dark			5	0
4. **Coal**	9′	0″		
5. Slate, bony	0	2		
6. **Coal**	2	6	11	8
7. Concealed				

A sample (No. 467R) was collected from Nos. 4 and 6 of section, the composition of which is published under **Mine No. 16** in the Table of Coal Analyses at the end of this Chapter.

The following opening is being driven into a small reservation reported to contain 500 to 600 tons, located in one of the hills northeast of Elk Garden, the great bulk of the original coal having been mined out by the Davis Coal and Coke Company followed with a second operation by the Jaffy Coal Mining Company:

Thos. Dixon Farm Mine—No. 17 on Map II.

On ridge 0.8 mile northeast of Elk Garden; **Pittsburgh Coal**; elevation, 2205′ B.

			Ft.	In.
1. Shale, sandy			5	0
2. Coal	1′	2″		
3. Slate, black	0	6		
4. Coal	6	8		
5. Slate, dark	0	4		
6. Coal	2	6	11	2
7. Shale, pavement				

A sample (No. 466R) was collected from Nos. 4 and 6 of section, the composition of which is published under **Mine No. 17** in the Table of Coal Analyses at the end of this Chapter.

Coal Exposure No. 18 on Map II is an old working in a small hillock in the northern environs of Elk Garden, having an elevation of 2275′ B. The opening is completely abandoned and fallen shut. **Coal Exposure No. 19 on Map II** is an abandoned working just south of the Elk Garden-Blaine highway, 0.4 mile southwest of Elk Garden, its elevation being 2340′ B.

In the summer of 1921 the Dean Coal Company had just started to reopen the Pittsburgh Coal in the ridge southwest of Elk Garden, two separate drifts being made at the same time, with the evident intention of recovering pillar coal left in place by earlier operations. Neither opening had progressed far enough to show coal sufficiently clean for sampling but the two sections, which follow, are of much interest:

Dean Coal Company No. 4 Mine (West Opening)—No. 20 on Map II.

On south side of North Branch of Potomac River, 0.3 mile southwest of Elk Garden; **Pittsburgh Coal**; elevation, 2315′ B.

			Ft.	In.
1. Shale, sandy				
2. Coal, reported	2′	6″		
3. Coal	6	10		
4. Shale, gray	0	2		
5. Coal	2	5	11	11
6. Shale, pavement				

Dean Coal Company No. 4 Mine (East Opening)—No. 21 on Map II.

In ridge 0.2 mile southwest of Elk Garden; **Pittsburgh Coal**; elevation, 2310′ B.

			Ft.	In.
1. Shale, sandy			10	0
2. **Coal**	1′	3″		
3. Shale	0	8		
4. **Coal**	8	6		
5. Slate, dark	0	2		
6. **Coal,** reported	4	0	14	7

The four-foot bench of coal, No. 6 of section, was not observed by the writer at this or any other mine in the neighborhood but was reported by a workman at the plant. The entry was still in the outcrop where the natural bedding beneath No. 4 was not visible so that verification of this report was not possible.

The **Dean Coal Company No. 2 Mine (No. 22 on Map II),** located at the western end of the same ridge and 0.6 mile southwest of Elk Garden, at an elevation of 2360′ B., had been abandoned, its section not being visible.

The following is a farm mine located at the extreme southern point of the same ridge and 0.2 mile southeast of Nethken School:

D. B. Ravenscroft Farm Mine—No. 23 on Map II.

On head of a branch of Abram Creek, 0.6 mile south of Elk Garden; **Pittsburgh Coal**; elevation, 2360′ B.

			Ft.	In.
1. Shale, sandy				
2. **Coal**	9′	0″		
3. Shale, 0′ 6″ to	0	2		
4. **Coal**	1	0		
5. **Coal,** reported	1	0	11	2

At the northern end of the next ridge south from Elk Garden the Smith Big Vein Coal Company holds a lease at the former location of the **Davis Coal & Coke Company No. 6 Mine,** part of the present operation being conducted by drift in the old pillars and part by stripping where there is less cover. The following is a section in the drift:

Smith Big Vein Coal Company No. 1 Mine—No. 24 on Map II.

In ridge west of Deep Run, 0.7 mile south of Elk Garden; **Pittsburgh Coal**; elevation, 2360′ B.

			Ft.	In.
1. Shale, sandy				
2. **Coal**	8′	8″		
3. Shale, gray, 0′ 2″ to	0	6		
4. **Coal**, visible	1	6		
5. **Coal**, reported	1	0	11	8
6. Shale, pavement				

"Principal office, Meyersdale, Pa.; coal owned by Davis Coal & Coke Company or West Virginia Central and Pittsburgh Railway (?); daily capacity, 100 tons; coal shipped west; 10 miners and 11 laborers employed; section in pillar off main heading; greatest rise, southeast; horse haulage; Owen Keegan, Mine Foreman, authority for data; sample (No. 509R) collected from Nos. 2 and 4 of section, for composition of which see **Mine No. 24** in the Table of Coal Analyses at the end of this Chapter."

The **Smith Big Vein Coal Company Mine (No. 25 on Map II)** is located in a saddle farther south in the same ridge and 0.8 mile northwest of Sulphur City at an elevation of 2440′ B., being a stripping operation served by the same haulage tracks and tipple as Mine No. 24, under which its mine data are included. A considerable amount of coal had been uncovered by steam shovel but the cut was partly filled with water so that only a few feet of its upper portion was exposed.

The **Dean Coal Company No. 3 Mine (Nos. 26, 27, and 28 on Map II)** operates along the Stony River Syncline north of Emoryville but the works were temporarily shut down, no full section of the coal being visible at any of the three openings. No. 26 is located on a branch of Abram Creek 0.8 mile northeast of Emoryville, at an elevation of 2395′ B., the mine mouth having fallen shut. No. 27 is one-fourth mile farther west on the same branch of Abram Creek and 0.7 mile northeast of Emoryville, with an elevation of 2405′ B., and had also fallen shut. No. 28 is a stripping operation on the south side of the same ridge and on the waters of Emory Run, 0.2 mile northeast of Emoryville, with an elevation of 2430′ B., there being no section exposed when the plant was visited.

Mine No. 30 on Map II is an abandoned working in an isolated hillock east of the syncline and 0.8 mile northeast of Wabash, its elevation being 2570′ B. In the long ridge east of Wabash there are several old entries, most of which have now been abandoned. **Exposure No. 31 on Map II** is located at the extreme eastern end of this ridge, 0.7 mile northwest of Hartmansville and 1 mile east of Wabash, its elevation being

2625′ B. **Exposure No. 32 on Map II** is on the north side of the ridge 0.7 mile east of Wabash, with an elevation of 2605′ B. **Exposure No. 33 on Map II** is also on the north side of the ridge 0.4 mile east of Wabash, with an elevation of 2600′ B.

At the following mine, located in the immediate vicinity of Wabash, there was still equipment on the ground but most of the coal appeared to have been worked out, only a somewhat uncertain section being obtainable:

James Cross et al. Mine—No. 34 on Map II.

On east side of Abram Creek, 0.1 mile south of Wabash; **Pittsburgh Coal**; elevation, 2575′ B.

			Ft.	In.
Shale, sandy				
Coal	6′	8″		
Slate, dark-gray	0	2		
Coal	2	8	9	6
Pavement (?)				

Pittsburgh ("Big Vein") Coal, Union District, Grant County.

In Grant County the Pittsburgh Coal horizon is entirely above the topography along the Stony River Basin but in the North Potomac Syncline a small amount of it has been preserved from erosion at the extreme head of the river in the western corner of Union District. In Fairfax Knob the outcrop consists of a few acres but has apparently been almost completely mined out and abandoned. Dr. I. C. White also reports an old opening in the top of Roger Camp Hill about one-half mile southeast of Fairfax Summit, where a small amount of it appears to have been preserved, its value being doubtful owing to the scanty cover. The following section, which is of much interest because of its isolation from other areas of the same coal, was measured at the old mine in the top of Fairfax Knob:

Davis Coal and Coke Company Mine—No. 35 on Map IV.

Near head of North Branch of Potomac River, on south slope of Fairfax Knob; **Pittsburgh Coal**; elevation, 3195′ B.

			Ft.	In.
Coal	0′	6″		
Shale, gray	0	2		
Coal	9	9		
Shale, gray	1	0		
Coal	1	0	12	5

The above section is at the mouth of the old mine where it has been exposed to the weather for a long time, being too much oxidized for sampling. It is not probable that any further Pittsburgh Coal can be recovered in Grant County.

Quantity of Pittsburgh ("Big Vein") Coal Available.

The following table, compiled by Tucker from a planimetric measurement of the outcrop, shows the probable amount of Pittsburgh Coal in the two counties before mining began:

Probable Amount of Pittsburgh ("Big Vein") Coal.

Districts.	Thickness of Coal Assumed. Feet.	Square Miles.	Acres.	Cubic Feet of Coal.	Short Tons of Coal.
Mineral County:					
Piedmont	12	0.43	275.2	143,852,544	5,754,101
Elk	12	2.65	1696.0	886,533,120	35,461,325
Totals		3.08	1971.2	1,030,385,664	41,215,426
Grant County:					
Union	11	0.05	32.0	15,333,120	613,325
Gr. Totals for Area		3.13	2003.2	1,045,718,784	41,828,751

In the above table an allowance has been made in the assumed thickness of the coal for impurities and local thinning of the bed but none has been made for the coal already mined, exact figures not being available. The seam has been so extensively exploited that it is doubtful whether more than 1 per cent. of the original area remains undisturbed, even if there be included old pillars which have recoverable coal. On such a basis the area would be reduced to 20.0 acres and the quantity to 418,287 short tons.

MINABLE COALS OF THE CONEMAUGH SERIES.

LITTLE PITTSBURGH COAL.

The Little Pittsburgh Coal, previously described in Chapter VII, page 211, is of apparent value only in the extreme western end of Grant County, being thin and impure in Mineral. On Fairfax Knob, Grant County, it was once mined commercially but the plant is not now in operation. Figure 14 shows the limited areas where it seems to be of minable thickness and purity.

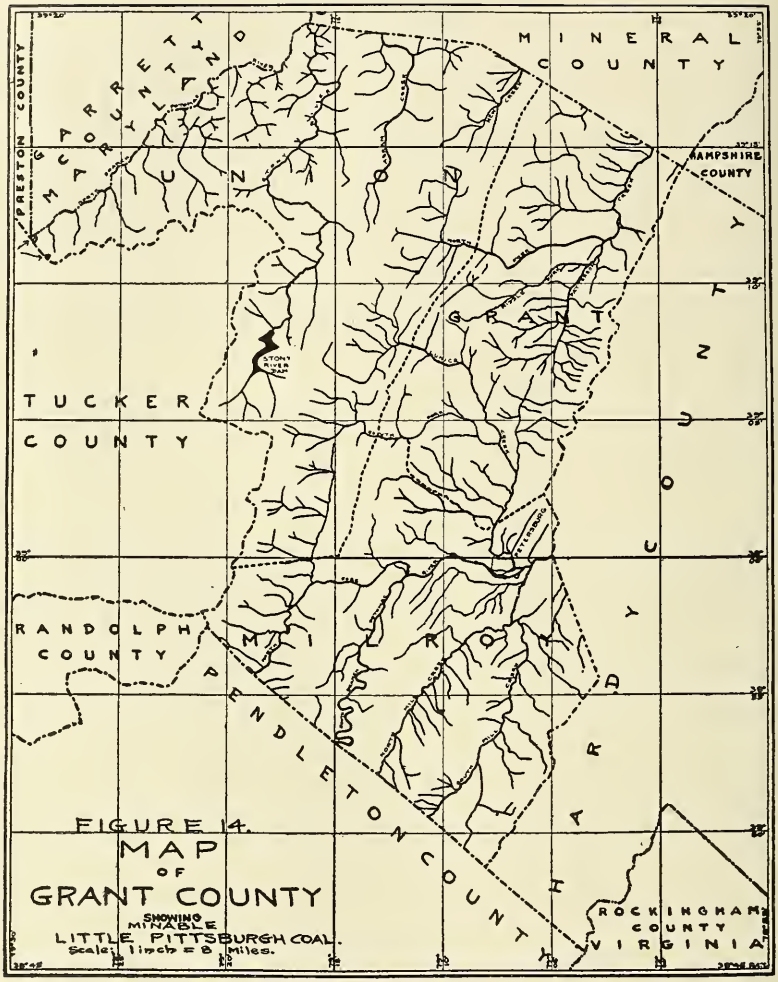


FIGURE 14.

MAP OF GRANT COUNTY SHOWING MINABLE LITTLE PITTSBURGH COAL.

Scale, 1 inch = 8 miles.

Photo by E. E. HARRIS.

PLATE XXIX.—View of Elk Garden, looking south. Topography above coal mine is Monongahela and that below is Conemaugh. Mine in right center is Pittsburgh ("Big Vein") Coal at East opening of Dean Coal Company No. 4 Mine (No. 21 on Map II).

Little Pittsburgh Coal, Piedmont District, Mineral County.

In Piedmont District the horizon of the Little Pittsburgh Coal occurs in the ridge between Montgomery and Piney Swamp Runs but no prospects nor exposures were observed, and it does not appear probable that the seam is of value, since this locality has been under exploitation for many years and a good coal could hardly have escaped attention.

Little Pittsburgh Coal, Elk District, Mineral County.

In Elk District the Little Pittsburgh Coal is exposed at a few points in the vicinity of Elk Garden where it is too thin for mining, as the following section shows:

Coal Exposure—No. 39 on Map II.

In road on the head of Deep Run at Sulphur City; **Little Pittsburgh Coal**; elevation, 2530′ L.

	Ft.	In.
Shale, dark		
Coal	1	3
Fire clay shale	0	5

The coal was also noted at **Coal Exposure No. 40 on Map II**, along the Elk Garden-Blaine road, 0.3 mile west of Elk Garden, where it is one foot thick and slaty, with an elevation of 2280′ B, as exhibited in the Elk Garden Section, page 168.

Little Pittsburgh Coal, Union District, Grant County.

In Union District the Little Pittsburgh Coal horizon occurs only at the head of North Branch of Potomac River in Fairfax Knob and Roger Camp Hill. In the former knob it was once mined commercially at the following locality:

Davis Coal & Coke Company Mine No. 61—No. 41 on Map IV.

On the south slope of Fairfax Knob, 0.2 mile north of Fairfax Summit; **Little Pittsburgh Coal**; elevation, 3100′ B.

			Ft.	In.
1. Sandstone, shaly, and sandy shale			10	0
2. Shale, dark, with **coal streaks**			1	6
3. **Coal**, hard	0′	8″		
4. Shale, dark	1	8		
5. **Coal**, good, soft	3	0		
6. Shale, gray	0	6		
7. **Coal**	0	7	6	5
8. Shale, pavement				

A sample (No. 383R) was collected from No. 5 of section, the composition of which is published under **Mine No. 41** in

the Table of Coal Analyses at the end of this Chapter. The analysis reveals a coal low in sulphur and ash but rather high in phosphorus.

Quantity of Little Pittsburgh Coal Available.

The following table, compiled by Tucker from a planimetric measurement of the approximate outcrop of the coal, shows the probable amount of Little Pittsburgh Coal in the region which contains it in minable thickness:

Probable Amount of Little Pittsburgh Coal.

District	Thickness of Coal Assumed. Feet.	Square Miles.	Acres.	Cubic Feet of Coal.	Short Tons of Coal.
Grant County:					
Union	3	0.10	64.0	8,363,520	334,541

LITTLE CLARKSBURG ("FRANKLIN," "DIRTY NINE-FOOT") COAL.

The Little Clarksburg ("Franklin," "Dirty Nine-foot") Coal, previously discussed in Chapter VII, page 212, appears to be of value only in Mineral County, the exposures in Grant being so thin that it can not be mined in the latter county. The seam has not been operated commercially in either county and when it exhibits its maximum thickness of seven or eight feet there are usually several shale binders that reduce its value and greatly increase the cost of mining. There is usually from 2 to 4 feet of clean coal, however, in Mineral County, and it is believed that its commercial exploitation will be eventually justified. Its Mineral County outcrop is delineated on Map II and its areal extent of mining value is indicated on Figure 15.

Little Clarksburg ("Franklin", "Dirty Nine-foot") Coal, Piedmont District, Mineral County.

In Piedmont District the Little Clarksburg Coal outcrops in some of the high ridges southeast of the North Potomac Syncline and has been opened and mined for local domestic fuel. It also occurs on the northwestern side of the basin in Garrett County, Maryland, there being 0′ 6″ of its blossom

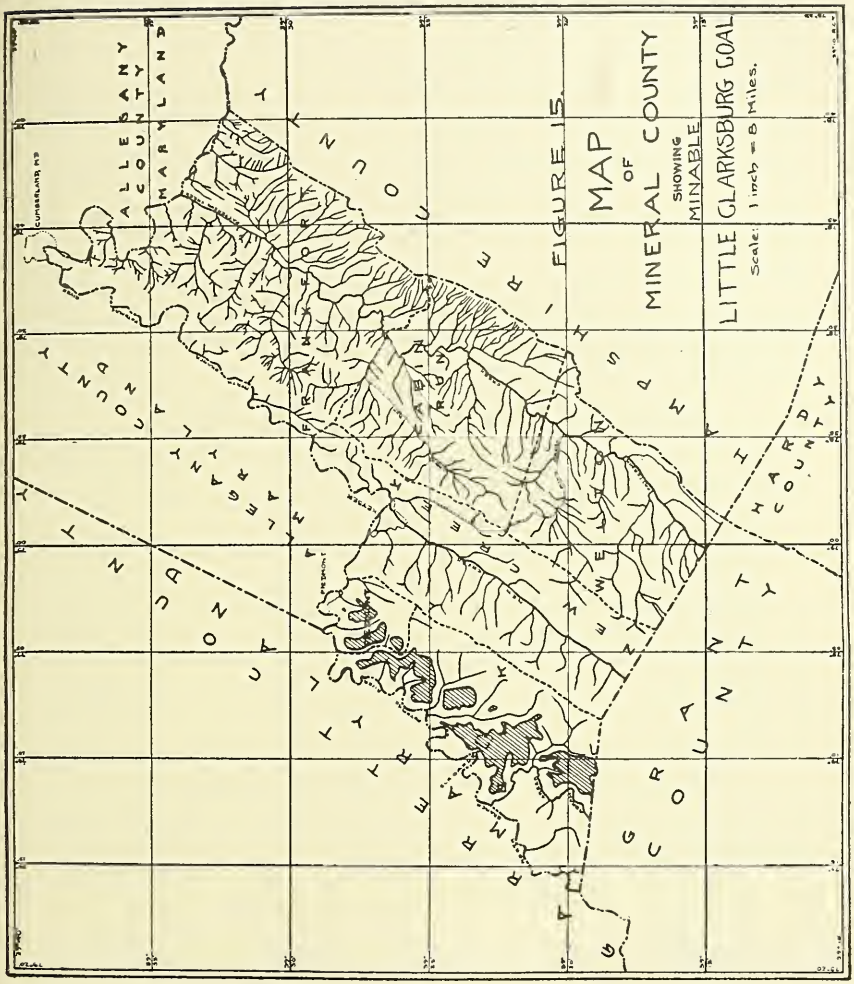


FIGURE 15.
MAP
OF
MINERAL COUNTY
SHOWING
MINABLE
LITTLE CLARKSBURG COAL
Scale: 1 inch = 8 Miles.
ALLEGANY COUNTY
MARYLAND
GARRETT COUNTY
PRESTON COUNTY
TUCKER COUNTY
RANDOLPH COUNTY
HARDY COUNTY
GRANT COUNTY
HAMPSHIRE COUNTY
CUMBERLAND MD
PATTERSON CREEK
NEW CREEK
SOUTH BRANCH
POTOMAC

visible at **Coal Exposure No. 44 on Map II,** on Franklin Hill 1.1 miles north of Bloomington, at elevation 1775′ B., as indicated in the Luke Section, page 158.

On the south side of the river it was once opened at the **Silver Coal Company Prospect (No. 45 on Map II)** on the west side of Montgomery Run 0.7 mile south of Hampshire, at elevation 1877′ B. This old prospect had fallen completely shut but according to Lewis Grant the coal measured 7′ 3″ thick, with partings, as recorded in the Piedmont Section, page 156.

The two following sections show its character farther southeast where it has little cover but has been mined for local fuel, there being a possibility that some of the top and bottom benches were not exposed:

Nalley Tract Farm Mine—No. 46 on Map II.

On head of Montgomery Run, 2.2 miles south of Piedmont; **Little Clarksburg Coal;** elevation, 2150′ B.

			Ft.	In.
Shale, sandy				
Coal, slaty			0	6
Shale, dark			2	3
Coal, bony	0′	9″		
Slate, bony	0	3		
Coal and bone, mixed	0	8		
Coal, good	2	6		
Slate, gray	0	1		
Coal, bony	0	8	4	11
Fire clay				

Nalley Tract Farm Mine—No. 47 on Map II.

On head of Montgomery Run, 2.2 miles south of Piedmont; **Little Clarksburg Coal;** elevation, 2400′ B.

			Ft.	In.
1. Shale, dark			6	0
2. **Coal,** soft	0′	10″		
3. Slate, bony	0	2		
4. **Coal,** soft	0	5½		
5. Slate, bony	0	4½		
6. **Coal,** soft	2	5		
7. Slate, dark	0	1		
8. **Coal,** soft	0	6	4	10
9. Fire clay				

A sample (No. 540R) was collected from Nos. 2, 4, and 6 of section, the composition of which is published under **Mine No. 47** in the Table of Coal Analyses at the end of this Chapter. The analysis reveals a coal low in sulphur and phosphorus but high in ash and much oxidized through lack of cover.

At **Coal Exposure No. 48 on Map II,** located at a road fork on the dividing ridge between Montgomery and Piney Swamp Runs, 0.2 mile southwest of Hampshire School, at elevation 2198′ L., its blossom is exposed but no section was obtainable.

Little Clarksburg ("Franklin", "Dirty Nine-foot") Coal. Elk District, Mineral County.

In Elk District the Little Clarksburg Coal has been prospected and mined for local fuel to a limited extent in the synclinal areas but few opportunities are at present afforded for study of its detailed section, although its outcropping blossom may be frequently noted. At **Coal Exposure No. 49 on Map II,** located on top of the ridge between North Branch of Potomac River and Piney Swamp Run, 0.5 mile east of Warnocks, at elevation 1745′ B., its blossom is exposed, as indicated in the Hampshire Section, page 163, a measurement of its thickness not being possible.

At **Coal Exposure No. 50 on Map II,** located at a private road fork west of Piney Swamp Run and 0.4 mile northeast of Cross School, there is a heavy blossom visible at an elevation of 1960′ B.

At the **Kalbaugh Coal Company Farm Mine (No. 51 on Map II)** the coal was once opened for domestic fuel on the ridge between North Branch of Potomac River and Piney Swamp Run 0.1 mile north of Cross School, at an elevation of 1910′ B., but the place has now been abandoned and no section is visible. According to Dr. Z. T. Kalbaugh, of Piedmont, the coal measured about 5′ 0″ thick, with partings.

At **Coal Exposure No. 52 on Map II,** along the mountain road 0.2 mile south of Cross School, the blossom is again exposed at elevation 1980′ B., indicating the rapid rise of this and all other coals toward the Allegheny Front.

At the following farm mine the coal is being used for local fuel. The abbreviated section shown, as compared to other localities, would indicate some possibility of another bench of coal at the top:

John Durham Farm Mine—No. 53 on Map II.

On branch of Howell Run, 1 mile southeast of Shaw; **Little Clarksburg Coal;** elevation, 1935′ B.

			Ft.	In.
1. Shale, dark, with coal streaks				
2. **Coal,** medium-hard	1′	10″		
3. Slate, dark	0	0½		
4. **Coal**	0	5½	2	4
5. Shale, gray, pavement				

A sample (No. 472R) was collected from Nos. 2 and 4 of section, the composition of which is published under **Mine No. 53** in the Table of Coal Analyses at the end of this Chapter.

At **Coal Exposure No. 54 on Map II,** on a branch of Deep Run, 0.5 mile east of Elk Garden, the blossom is visible in the road at an elevation of 2100′ B., no section being obtainable.

At **Coal Exposure No. 55 on Map II,** along the Blaine-Elk Garden road, 0.5 mile southeast of Blaine, there is a heavy blossom of the coal visible at an elevation of 2225′ B., as recorded in the Elk Garden Section, page 169.

At **Coal Exposure No. 56 on Map II,** on a branch of Emory Run of Abram Creek, 0.7 mile northwest of Hartmansville, there is one foot of coal visible near the road fork, its elevation being 2525′ B.; and at **Coal Exposure No. 57 on Map II,** there is a two-foot outcrop in the road along a branch of Abram Creek, 0.8 mile south of Emoryville, with an elevation of 2350′ B.

Little Clarksburg ("Franklin", "Dirty Nine-foot") Coal, Union District, Grant County.

In Grant County there are only a few exposures of Little Clarksburg Coal and these indicate a seam that is too thin or slaty for successful mining. On the Maryland side of the Potomac, also, it is visible at several points along ridge roads near the axis of the North Potomac Syncline but apparently does not have minable thickness and quality.

At the **Davis Coal & Coke Company Prospect (No. 58 on Map IV),** located on the eastern slope of Fairfax Knob, Grant County, it was once opened at an elevation of 3080′ B., measuring 1′ 4″ with a central parting, as recorded in the Fairfax Section, page 191.

Quantity of Little Clarksburg ("Franklin", "Dirty Nine-foot") Coal Available.

The following table, compiled by Tucker from a planimetric measurement of the outcrop on Map II, shows the probable amount of Little Clarksburg Coal in Mineral County:

Probable Amount of Little Clarksburg ("Franklin," "Dirty Nine-foot") Coal.

Districts.	Thickness of Coal Assumed. Feet.	Square Miles.	Acres.	Cubic Feet of Coal.	Short Tons of Coal.
Mineral County:					
Piedmont	2	1.75	1,120.0	97,574,400	3,902,976
Elk	2	11.10	7,104.0	618,900,480	24,756,019
Totals		12.85	8,224.0	716,474,880	28,658,995

ELK LICK ("BARTON," "FOUR-FOOT") COAL.

The Elk Lick Coal, previously described in Chapter VII, page 217, which as therein explained, has long been erroneously known as the "Bakerstown Coal" in the Potomac region, has been mined commercially for many years in Mineral County, its thickness and section being quite constant at nearly all points where its horizon occurs. In Grant County it is of minable thickness in the northeastern part of Union District in the vicinity of Mount Storm and other points, and has been used for local domestic fuel but not for commercial shipment; but in the western end of the district toward the head of the Potomac River it gradually thins out and becomes of little or no value. This coal, in general, is quite hard and blocky, standing shipment better than any other coal in the valley and being for that reason much favored as a domestic fuel for which it is largely used. The seam contains much bone which must be carefully removed in mining and even then is fairly high in ash as well as in sulphur and phosphorus, but its carbon content is so high that its heating value is very good. Its outcrop is shown on Maps II and IV in the region where it is known or thought to be of minable thickness and Figures 16 and 17 indicate at a glance its areal extent of commercial thickness.

Elk Lick ("Barton," "Four-foot") Coal, Piedmont District, Mineral County.

In Piedmont District the Elk Lick Coal occupies a considerable area in the ridges which jut out against the Potomac but overshoots the topography southeastward toward the Allegheny Front. It is mined commercially at several open-

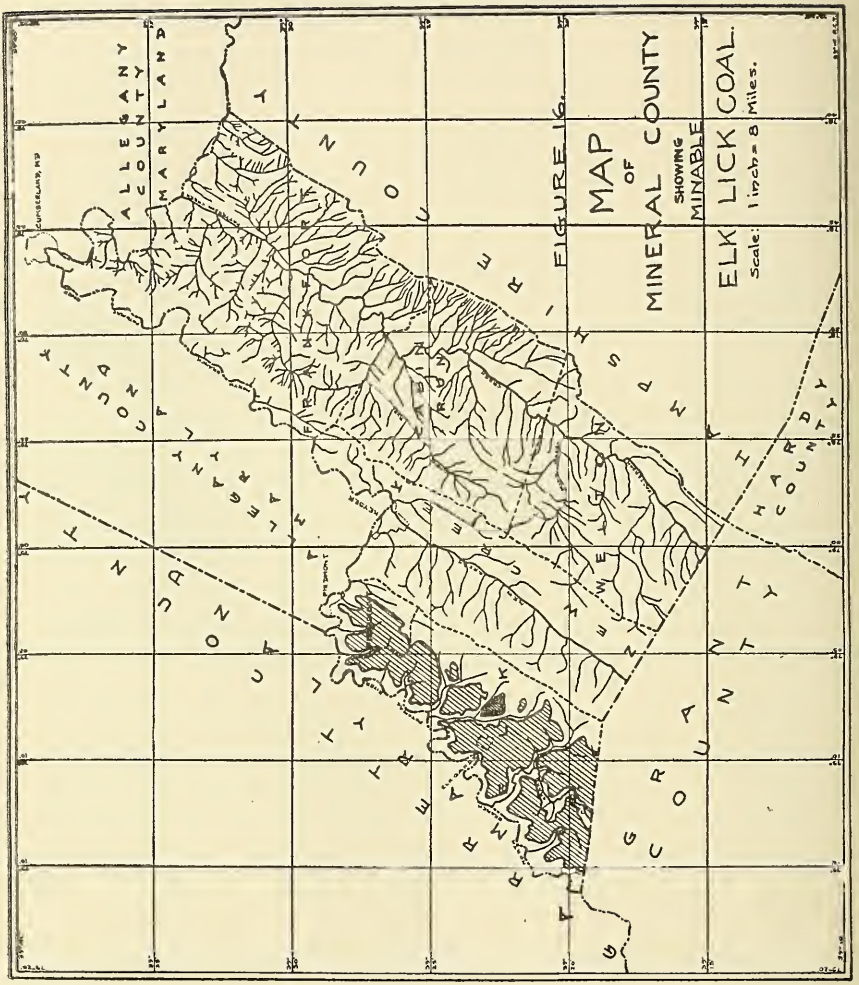
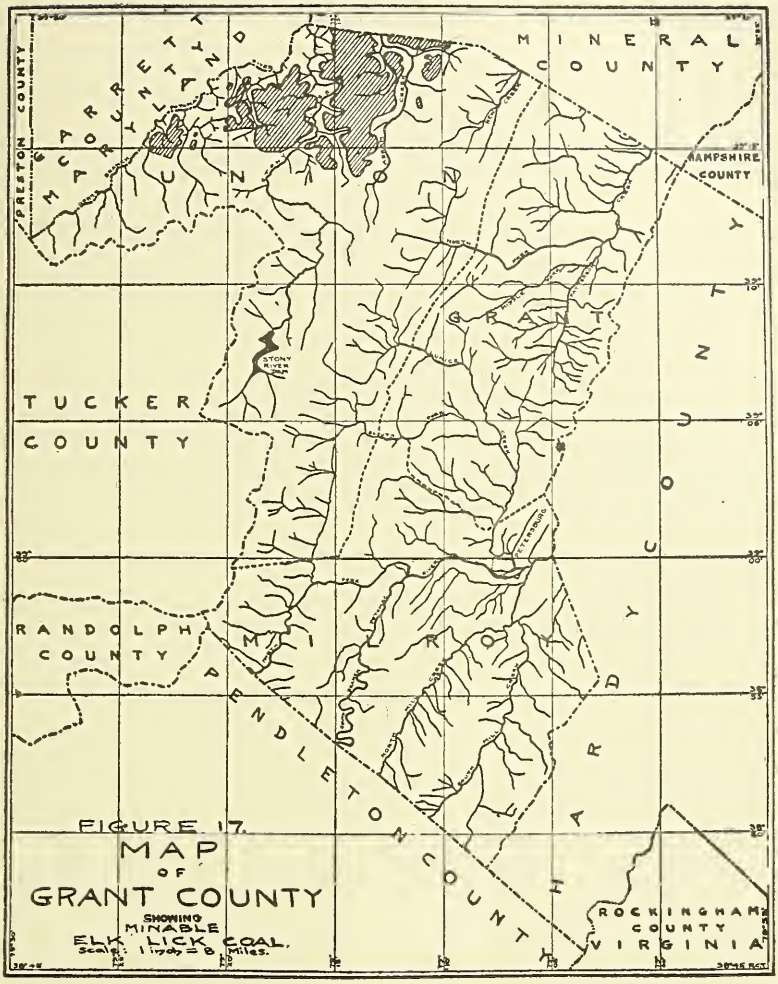

ALLEGANY COUNTY
MARYLAND
GARRETT COUNTY
HARDY COUNTY
GRANT COUNTY
MAP
OF
MINERAL COUNTY
SHOWING
MINABLE
ELK LICK COAL.
Scale: 1 inch = 8 Miles.

FIGURE 16.


PRESTON COUNTY
MINERAL COUNTY
HAMPSHIRE COUNTY
GRANT
TUCKER COUNTY
RANDOLPH COUNTY
PENDLETON COUNTY
ROCKINGHAM COUNTY VIRGINIA
STONY RIVER
SHENANDOAH MOUNTAIN
FIGURE 17.
MAP OF GRANT COUNTY
SHOWING MINABLE ELK LICK COAL.
Scale: 1 inch = 8 miles.

ings, most of which are on the southeastern side of the North Potomac Syncline. The following abandoned mine is located on the Maryland side of the Potomac and shows the northern continuity of the coal, the section having been measured about 100 feet within the old entry mouth:

Davis Coal & Coke Company Mine (Abandoned)—No. 72 on Map II.

On Franklin Hill, 0.7 mile northeast of Bloomington, Garrett County, Maryland; **Elk Lick Coal**; elevation, 1520′ B.

			Ft.	In.
Shale, dark				
Coal, medium-hard	1′	2″		
Shale, dark	0	8		
Coal, soft	2	8	4	6
Shale, pavement				

The coal has also been mined extensively at the **G. C. Patterson Mine (No. 73 on Map II)**, located in Garrett County, Maryland, on the south side of Savage River, 1.2 miles northwest of Bloomington, being 3′ 9″ thick, and bony at the top, with an elevation of 1625′ B., as detailed in the Bloomington Section, page 160.

The following mine, formerly known as the **Davis Coal & Coke Company No. 51**, is located on the West Virginia side of the Potomac and is still an active operation, although temporarily idle when it was examined:

Silver Coal Company No. 2 Mine—No. 74 on Map II.

On east side of Montgomery Run, 0.4 mile south of West Virginia Central Junction; **Elk Lick Coal**; elevation, 1726′ B.

			Ft.	In.
1. Shale, dark				
2. **Coal**, slaty	0′	4″		
3. Shale, gray	1	10		
4. **Coal**, bony	1	10		
5. "Black-jack"	0	3		
6. **Coal**, soft	2	9		
7. Slate, dark	0	1		
8. **Coal**, bony	0	5	7	6
9. Fire clay shale				

"Principal office, Luke, Maryland; coal leased from the Davis Coal & Coke Company; daily capacity, 175 tons; 30 miners and 15 laborers employed; electric haulage; coal shipped east for steam and domestic purposes; greatest rise, southeast; Lewis Grant, Superintendent, authority for mine data; sample (No. 529R) collected from No. 6 of section, in Main Heading, for composition of which see **Mine No. 74** in the Table of Coal Analyses at the end of this Chapter."

The following is another active operation on the west side of the same stream, although temporarily idle when ex-

amined. It was formerly known as the **Davis Coal & Coke Company No. 50:**

Silver Coal Company No. 3 Mine—No. 75 on Map II.

On the west side of Montgomery Run, 0.7 mile southwest of West Virginia Central Junction; **Elk Lick Coal**; elevation, 1680′ B.

			Ft.	In.
1. Shale, dark				
2. **Coal**, bony	1′	4″		
3. "Black-jack"	0	3½		
4. **Coal**, soft	2	3½		
5. **Coal**, bony, reported	0	6	4	5
6. Shale				

"Principal office, Luke, Maryland; coal leased from the Davis Coal and Coke Company; daily capacity, 125 tons; 22 miners and 12 laborers employed; electric and mule haulage; coal shipped east for steam and domestic purposes; greatest rise, southeast; Lewis Grant, Superintendent, authority for mine data; sample (No. 528R) collected from No. 4 of section in the First Dip, Room No. 3, for composition of which see **Mine No. 75** in the Table of Coal Analyses at the end of this Chapter."

The **Masteller Coal Company No. 1 Mine (No. 76 on Map II)**, located just northwest of the axis of the North Potomac Syncline and on the high hill south of North Branch of Potomac River 0.4 mile southeast of Hampshire, at an elevation of 1485′ B., is now abandoned and fallen shut.

The **Masteller Coal Company No. 3 Mine (No. 77 on Map II)**, located on the eastern side of Piney Swamp Run 1.3 miles southwest of Hampshire, at an elevation of 1565′ B., has also been abandoned. The **Masteller No. 2 Mine**, which is also abandoned, was located along the same haulage track which joins Nos. 1, 3, and 4, but its position and elevation were not secured and it does not appear on Map II. The following is an active operation of the same company:

Masteller Coal Company No. 4 Mine—No. 78 on Map II.

On east side of Piney Swamp Run, 1.5 miles southwest of Hampshire; **Elk Lick Coal**; elevation, 1615′ B.

			Ft.	In.
1. Sandstone, massive				
2. Wild **coal**, slaty			0	6
3. Shale, dark, 3′ to			6	0
4. **Coal**, bony	0′	3″		
5. Bone	0	1		
6. **Coal**, bony	0	5		
7. "Black-jack" (bone)	0	6		
8. **Coal**, medium-hard	2	5		
9. Bone	0	1	3	9
10. Shale, pavement				

"Principal office, Keyser, W. Va.; daily capacity, 25 tons; 60 miners and 24 laborers employed; storage battery motor and mule haulage; coal shipped east for domestic purposes; butts, northwest; faces, southwest; greatest rise, southeast; Martin L. Watson, Superintendent, authority for data; sample (No. 497R) collected from No. 8 of section in Third Butt Heading off Second Right, for composition of which see Mine No. 78 in the Table of Coal Analyses at the end of this Chapter."

At the **Charles Tasker Prospect (No. 79 on Map II)**, located on the north side of Piney Swamp Run 1.1 miles northeast of Tasker School, at an elevation of 2450′ B., the old opening had fallen shut but the coal was reported as three feet or more in thickness by Mr. Tasker. Here the rocks are rising very rapidly southeastward toward the Allegheny Front but the identification of this prospect is made certain by the Ames Shale fossils occurring in the roof shales of Coal Prospect No. 145 on Map II just southward on the slope of the same hillside.

Elk Lick ("Barton," "Four-foot") Coal, Elk District, Mineral County.

In Elk District the Elk Lick Coal underlies a wide acreage in the synclinal areas and is being actively mined at several operations. The following is one of the Masteller plants:

Masteller Coal Company No. 5 Mine—No. 80 on Map II.

On west side of Piney Swamp Run, 0.9 mile southwest of Hampshire; **Elk Lick Coal**; elevation, 1510′ B.

			Ft.	In.
1. Shale, dark				
2. **Coal**, bony	0′	7½″		
3. Slate, dark	0	1½		
4. **Coal**, bony	0	8		
5. Slate, dark	0	3		
6. **Coal**, medium-soft	2	5		
7. Bone	0	2	4	3
8. Shale, pavement				

"Principal office, Keyser, W. Va.; coal leased from The New Creek Company of Philadelphia; daily capacity, 150 tons; 26 miners and 6 laborers employed; mule haulage; coal shipped east for domestic purposes; butts, northwest; faces, southwest; greatest rise, northwest; Martin L. Watson, Superintendent, authority for mine data; sample (No. 498R) collected from No. 6 of section in First Butt off First Left in new No. 5 Mine north of old entry, for the composition of which see Mine No. 80 in the Table of Coal Analyses at the end of this Chapter."

The following is a prospect farther south in the same ridge:

Masteller Coal Company Prospect—No. 81 on Map II.

On west side of Piney Swamp Run, 0.9 mile southwest of Hampshire; **Elk Lick Coal**; elevation, 1505′ B.

			Ft.	In.
Shale, dark				
Coal, bony, and bone	1′	5″		
Coal, good	2	8	4	1
Shale, pavement				

The following is a farm mine located along the Potomac frontage:

Farm Mine—No. 82 on Map II.

On east side of North Branch of Potomac River, 1 mile northeast of Barnum; **Elk Lick Coal**; elevation, 1575′ B.

			Ft.	In.
Shale, dark				
Coal			1	0
Shale, dark			5	0
Coal, bony	0′	8″		
Slate, dark	0	1		
Coal, bony	0	8		
Coal, soft	2	10	4	3
Shale, pavement				

The **Monroe Coal Mining Company Mine (No. 83 on Map II)**, located in Garrett County, Maryland, in the hill west of the Potomac River 0.3 mile west of Barnum, at elevation 1660′ B., is abandoned and partly fallen shut. The Barnum Section, page 164, shows its relationship to the lower coals formerly mined in the same hillside.

Three openings in the Elk Lick Coal have been made by the Kalbaugh Coal Company on a large tract along the West Virginia side of the Potomac southeast of Barnum. The **Kalbaugh Coal Company Mine (No. 84 on Map II)** is the entry at the head of the plane and 0.5 mile southeast of Barnum, its elevation being 1620′ B., and its section much the same as the main mine. The **Kalbaugh Coal Company Mine (No. 85 on Map II)** is an abandoned entry along the mine haulage track, 0.6 mile southeast of Barnum, its elevation being 1630′ B. The following is a section in the main mine where the operation was temporarily idle:

Kalbaugh Coal Company Mine—No. 86 on Map II.

On east side of North Branch of Potomac River, 0.7 mile southeast of Barnum; **Elk Lick Coal**; elevation, 1620′ B.

			Ft.	In.
1. Shale, dark				
2. **Coal**, bony	1′	1″		
3. **Coal**, soft	2	4		
4. Bone	0	6	3	11
5. Shale, pavement				

"Principal office, Cumberland, Maryland; daily capacity, 100 tons; 18 miners and 10 laborers employed; mule haulage; coal shipped east for steam fuel; greatest rise, southeast; no butts or faces; Thos. Walsh, Superintendent, authority for mine data; sample (No. 501R) collected from No. 3 of section in First Right off Main Heading, for composition of which see **Mine No. 86** in the Table of Coal Analyses at the end of this Chapter."

The following is another mine where work had temporarily suspended in the general shut-down of 1921:

H. P. Brydon and Bro., Inc., (Shaw) Mine—No. 87 on Map II.

On the south side of North Branch of Potomac River, 0.9 mile northeast of Shaw; **Elk Lick Coal**; elevation, 1625′ B.

			Ft.	In.
1. Shale, dark				
2. **Coal**, bony	1′	0″		
3. **Coal**, soft	2	1	3	1
4. Shale, gray, pavement				

"Principal office, Piedmont, W. Va.; coal owned by the Big Vein Coal Company of Baltimore, Maryland; daily capacity, 125 tons; 40 miners and 10 laborers employed; mule haulage; coal shipped east for domestic use; no butts or faces; greatest rise, south; Joseph Harvey, Mine Foreman, authority for mine data; sample (No. 507R) collected from No. 3 of section in Main Heading, 400 feet in, for composition of which see **Mine No. 87** in the Table of Coal Analyses at the end of this Chapter."

At **Coal Exposure No. 88 on Map II**, located on the north side of Howell Run 0.4 mile southeast of Shaw, at an elevation of 1655′ B., there is 1′ 4″ of coal visible, as reported in the Howell Run Section, page 165; and at **Coal Exposure No. 89 on Map II**, located in the road ascending the hill up the east side of North Branch of Potomac River, 0.5 mile southwest of Shaw, at an elevation of 1700′ B., only the blossom is visible, as recorded in the Shaw Section, page 167.

The **John Barrick Prospect (No. 89A on Map II)**, located on a branch of Howell Run 1.5 miles southeast of Shaw, at an

elevation of 2000′ B., had fallen shut, the coal being reported as four feet thick by the owner.

On the east side of Deep Run, near Nethken, the Deep Run Big Vein Coal Company has three entries in the Elk Lick Coal, with connected outside haulage and served by a single plane to the foot of the hill, all of them being temporarily inactive when visited. The section of the most northern opening, measured at the mouth of the mine, is as follows:

Deep Run Big Vein Coal Company (Grant No. 2) Mine—No. 90 on Map II.

On east side of Deep Run, 0.5 mile northeast of Nethken; **Elk Lick Coal**; elevation, 1805′ B.

			Ft.	In.
Shale, dark				
Slate, cannel			2	6
Coal, soft	2′	2″		
Coal, bony	0	6	2	8
Shale, pavement				

For mine data see Grant No. 1 Mine (No. 91 on Map II).

The following opening is next in succession, passing southward:

Deep Run Big Vein Coal Company (Grant No. 1) Mine—No. 91 on Map II.

On east side of Deep Run, 0.4 mile northeast of Nethken; **Elk Lick Coal**; elevation, 1810′ B.

			Ft.	In.
1. Shale, dark				
2. Slate, cannel			2	6
3. **Coal**, bony	0′	3″		
4. **Coal**, soft	2	2		
5. "Black-jack"	0	3	2	8
6. Shale, pavement				

"Principal office, Elk Garden, W. Va.; coal owned by operating company; daily capacity, 300 tons; 40 miners and 15 laborers employed; gasoline motor and mule haulage; coal shipped east for steam fuel; butts, due south; faces, due east; greatest rise, southeast; H. B. Kight, Superintendent, and C. H. Lantz, President, authorities for mine data; sample (No. 503R) collected from No. 4 of section at face of Main Heading, for composition of which see **Mine No. 91** in the Table of Coal Analyses at the end of this Chapter."

The above mine data are inclusive for Grant Nos. 1, 2, and 3 Mines. The following is the most southern opening:

Deep Run Big Vein Coal Company (Grant No. 3) Mine—No. 92 on Map II.

On the east side of Deep Run, 0.3 mile northeast of Nethken; **Elk Lick Coal**; elevation, 1855′ B.

			Ft.	In.
1. Shale, dark				
2. Slate, cannel			1	7
3. **Coal**, bony	0′	5″		
4. **Coal**, soft	2	4		
5. **Coal**, bony	0	10	3	7
6. Shale, pavement				

A sample (No. 504R) was collected from No. 4 of section at the face of the Main Heading, the composition of which is published under **Mine No. 92** in the Table of Coal Analyses at the end of this Chapter. For mine data, see Grant No. 1 (No. 91 on Map II).

On the west side of Deep Run the Jaffy Coal Mining Company has four closely connected entries in the Elk Lick Coal, served by a general haulage track and single plane and tipple. Operations here had temporarily suspended, the two principal entries showing the following sections:

Jaffy Coal Mining Company (No. 4 Swayne) Mine—No. 93 on Map II.

On west side of Deep Run, 0.7 mile northwest of Nethken; **Elk Lick Coal**; elevation, 1770′ B.

			Ft.	In.
1. Shale, dark				
2. Slate, cannel	0′	9″		
3. **Coal**, bony	0	8		
4. **Coal** and bone	0	9		
5. **Coal**, soft	2	8		
6. Bone, 0′ 6″ to	0	10	5	8
7. Shale, pavement				

"Principal office, Elk Garden, W. Va.; coal partly owned by the operating company and partly leased from W. Va. Central and Pittsburgh Railway; daily capacity, 250 tons; 33 miners and 11 laborers employed; mule and horse haulage; coal shipped east for steam and domestic fuel; butts, N. 30° W.; faces, N. 60° E.; greatest rise, southwest; C. H. Lantz, Secretary, and A. R. Middleton, Foreman, authorities for mine data; sample (No. 505R) collected from No. 5 of section, at end of Main Heading, 200 feet in, for composition of which see **Mine No. 93** in the Table of Coal Analyses at the end of this Chapter."

The above mine data are inclusive for Swayne Nos. 1, 2, 3, and 4 Mines.

Photo by E. E. HARRIS.

PLATE XXX.—View from Kitzmiller, Maryland, looking southeastward across North Branch of Potomac River with town of Blaine on West Virginia side. Mine chute at left center is that of Fortney and Piles (No. 285 on Map II) in Mahoning Coal and that in center with tipple and incline is the Grafton Mining Company "Freeport" Mine (Nos. 202 and 203 on Map II) in Bakerstown Coal. Topography of Conemaugh and Allegheny Series.

Jaffy Coal Mining Company (No. 3 Swayne) Mine—No. 94 on Map II.

On west side of Deep Run, 0.3 mile northwest of Nethken; **Elk Lick Coal**; elevation, 1805′ B.

		Ft.	In.
Shale, dark			
Slate, cannel		0	6
Coal, bony	0′ 11″		
Coal, soft	2 6		
Bone	0 6	3	11
Shale, pavement			

For mine data, see Swayne No. 4 Mine (No. 93 on Map II).

Coal Prospect No. 95 on Map II, located along the road leading up a branch of Deep Run, 0.7 mile east of Elk Garden, at an elevation of 1895′ B., had partly fallen shut, there being 2 feet of coal visible.

The two following mines are farm openings farther south:

Jack Jones Farm Mine—No. 96 on Map II.

On west side of Deep Run, 1.1 miles southeast of Elk Garden; **Elk Lick Coal**; elevation, 2010′ B.

		Ft.	In.
1. Shale, dark			
2. Slate, cannel		0	7
3. **Coal**, bony	0′ 7″		
4. **Coal**, soft	2 3		
5. **Coal**, bony	0 7	3	5
6. Shale, pavement			

A sample (No. 511R) was collected from No. 4 of section, the composition of which is published under **Mine No. 96** in the Table of Coal Analyses at the end of this Chapter.

James R. Green Heirs Farm Mine—No. 97 on Map II.

On south side of Deep Run, 0.6 mile southeast of Sulphur City; **Elk Lick Coal**; elevation, 2620′ B.

		Ft.	In.
1. Shale, dark			
2. **Coal**, bony	0′ 10″		
3. Slate, soft, bony	0 2		
4. **Coal**, soft	2 6		
5. Slate, hard, dark	0 2		
6. **Coal**, bony	0 7	4	3
7. Fire clay, pavement			

A sample (No. 473R) was collected from No. 4 of section, the composition of which is published under **Mine No. 97** in the Table of Coal Analyses at the end of this Chapter.

The **Grafton Mining Company Prospect (No. 98 on Map II)**, located on the south side of North Branch of Potomac River 0.2 mile south of Blaine, at an elevation of 2130′ B., had fallen shut, the coal being reported as one foot thick, as recorded in the Elk Garden Section, page 169.

On Abram Creek and its waters the Elk Lick Coal is being worked extensively. The **Donley Coal Company Farm Mine (No. 99 on Map II)**, on a branch of Abram Creek 1 mile northeast of Oakmont, with an elevation of 2075′ B., had fallen completely shut when visited, no report being obtained as to its thickness.

On the south side of the same branch the Mapleville Coal Company has two openings, the following of which is now inactive:

Mapleville Coal Company No. 1 Mine—No. 100 on Map II.

On branch of Abram Creek, 0.8 mile east of Oakmont; **Elk Lick Coal**; elevation, 2095′ B.

			Ft.	In.
Shale, dark				
Slate, cannel			1	11
Coal, bony	0′	5″		
Coal, soft	0	5		
Bone	0	1		
Coal, soft	1	3		
Bone, reported	0	8	2	10
Shale, pavement				

The eastern opening of the same company, which supplies locomotive fuel for the Elk Garden Branch of the Western Maryland Railway and was one of the few active mines in the season of 1921, shows the following:

Mapleville Coal Company Mine—No. 101 on Map II.

On a branch of Abram Creek, 1 mile east of Oakmont; **Elk Lick Coal**; elevation, 2075′ B.

			Ft.	In.
1. Shale, dark				
2. **Coal**, bony	1′	3″		
3. Slate, cannel	2	4		
4. Bone	0	4		
5. **Coal**, soft	0	6		
6. Bone	0	1		
7. **Coal**, soft	1	4		
8. Bone, reported	0	8	6	6
9. Shale, pavement				

"Principal office, Elk Garden, W. Va.; daily capacity, 40 tons; 12 miners and 8 laborers employed; mule haulage; coal used locally for railroad fuel and also shipped east for domestic purposes; greatest rise, northwest; O. G. Harris, authority for mine data; sample (No. 515R) collected from Nos. 5 and 7 of section at end of air-course, for composition of which see Mine No. 101 in the Table of Coal Analyses at the end of this Chapter."

The five following mines are small commercial operations on Emory Run of Abram Creek:

Miller and Lemon Coal Mine—No. 102 on Map II.

On the north side of Emory Run, 0.4 mile east of Emoryville Station; **Elk Lick Coal**; elevation, 2080′ B.

			Ft.	In.
1. Shale, dark				
2. **Coal**, bony	0′	9″		
3. Slate, cannel	1	1		
4. **Coal**, soft	1	9		
5. Slate, dark	0	1		
6. **Coal**, soft	0	6	4	2
7. Shale, pavement				

A sample (No. 525R) was collected from Nos. 4 and 6 of section, the composition of which is published under **Mine No. 102** in the Table of Coal Analyses at the end of this Chapter. This mine was temporarily idle, there being no one in charge to furnish mine data. The section was measured about 100 feet in the Main Heading, beyond which point further entrance was shut off by water, the dip being northwest.

Pritts Bros. Coal Company Mine—No. 103 on Map II.

On east side of Emory Run, 0.5 mile southeast of Emoryville Station; **Elk Lick Coal**; elevation, 2090′ B.

	Ft.	In.
1. Shale, dark		
2. Slate, cannel	1	6
3. **Coal**, 2′ 7″ to	1	11
4. Slate, pavement		

"Principal office, Emoryville, W. Va.; coal partly owned by operating company and partly leased from Nethken Heirs; daily capacity, 80 tons; 12 miners and 1 laborer employed; pony haulage; coal shipped east for domestic use; greatest rise, north; H. J. Pritts, President, authority for mine data; sample (No. 522R) collected from No. 3 of section in Second Left, for composition of which see **Mine No. 103** in the Table of Coal Analyses at the end of this Chapter."

The above mine was in active operation when visited.

Clise Bros. Coal Company Mine—No. 104 on Map II.

On west side of Emory Run, 0.4 mile southeast of Emoryville Station; **Elk Lick Coal**; elevation, 2100′ B.

			Ft.	In.
1.	Shale, dark			
2.	Bone		1	0
3.	**Coal**, medium-soft	0′ 6″		
4.	Bone	0 3		
5.	**Coal**, bony	0 7		
6.	**Coal**, soft	1 11		
7.	Slate	0 1		
8.	**Coal**	0 8	4	0
9.	Shale, pavement			

"Principal office, Emoryville, W. Va.; coal leased from Bakertown Coal Company; coal owned by W. Va. Central and Pittsburgh Railway; daily capacity, 50 tons; 6 miners and 3 laborers employed; pony haulage; coal shipped east for general use; greatest rise, southeast; Chas. H. Clise, General Manager; authority for mine data; sample (No. 524R) collected from Nos. 3 and 6 of section in Main Heading, for composition of which see **Mine No. 104** in the Table of Coal Analyses at the end of this Chapter."

Low Volatile Coal Company No. 1 Mine—No. 105 on Map II.

On the west side of Emory Run, 0.6 mile southeast of Emoryville Station; **Elk Lick Coal**; elevation, 2095′ B.

			Ft.	In.
1.	Shale, dark			
2.	**Coal**, bony	0′ 10″		
3.	Slate, cannel	0 4		
4.	**Coal**, bony	0 4		
5.	**Coal**, soft	1 0		
6.	Slate, dark	0 1		
7.	**Coal**, soft	1 0		
8.	Slate, dark	0 1		
9.	**Coal**, medium-hard	0 6	4	2
10.	Shale, pavement			

"Principal office, Emoryville, W. Va.; coal owned by operating company; daily capacity, 100 tons; 18 miners and 7 laborers employed; mule haulage; coal shipped east for steam and domestic purposes; greatest rise, southeast; S. C. Green, Mine Foreman, authority for mine data; sample (No. 527R) collected from Nos. 5, 7, and 9 of section in pillar off First Right Heading, for composition of which see **Mine No. 105** in the Table of Coal Analyses at the end of this Chapter."

Vanderber Coal & Coke Company Mine—No. 106 on Map II.

On east side of Emory Run, 0.9 mile southeast of Emoryville Station; **Elk Lick Coal**; elevation, 2130′ B.

			Ft.	In.
1. Shale, dark				
2. **Coal**, medium-soft	1′	1″		
3. Slate, cannel	0	6		
4. **Coal**, soft	1	1		
5. **Coal**, bony	0	6	3	2
6. Shale, pavement				

"Principal office, Emoryville, W. Va.; coal owned by operating company; daily capacity, 100 tons; 15 miners and 3 laborers employed; mule haulage; coal shipped east for steam and domestic fuel; greatest rise, southeast; M. D. Morgan, Superintendent, authority for mine data; sample (No. 526R) collected from Nos. 2 and 4 of section in Main Heading at face about 300 feet in, for composition of which see **Mine No. 106** in the Table of Coal Analyses at the end of this Chapter."

The following is a farm mine near the head of the run, where the rapid southeastward rise toward the Allegheny Front begins:

Reese Duling Coal Opening—No. 107 on Map II.

On south side of Emory Run, 0.6 mile northeast of Hartmansville; **Elk Lick Coal**; elevation, 2605′ B.

			Ft.	In.
Shale, dark				
Coal, bony	1′	5″		
Coal, soft	2	8	4	1
Shale, pavement				

The following mine, located farther up the steep strata of the Allegheny Front, employs a short slope to reach the coal which is about 15 feet underground, but which soon overshoots the mountain southeastward. The mine has no railroad connection, its output being hauled by truck mainly to Keyser and the New Creek Valley for domestic fuel:

Mont Alto Coal Company Mine—No. 108 on Map II.

On south side of Emory Run, 0.5 mile northeast of Hartmansville; **Elk Lick Coal**; elevation, 2785′ B.

			Ft.	In.
1. Shale, dark, slickensided				
2. Bone	0′	3″		
3. **Coal**, bony	0	10		
4. **Coal**, soft	1	0½		
5. Shale, black	0	0½		
6. **Coal**, soft	1	6		
7. Bone	0	8	4	4
8. Shale, pavement				

"Principal office, Keyser, W. Va.; Frank H. Babb, Secretary; capacity, 25 tons; 4 miners employed; coal sold to local domestic trade; greatest rise, southeast; Edgar Shillingburg, Superintendent, authority for mine data; sample (No. 475R) collected from Nos. 4 and 6 of section, for the composition of which see **Mine No. 108** in the Table of Coal Analyses at the end of this Chapter."

The following are the two commercial entries of the Bakertown Coal Company, both of which are in the angle between Emory Run and Abram Creek, there being a single plane and tipple. The name of the company reflects the former prevalent belief that the coal now being described was the Bakerstown:

Bakertown Coal Company Mine (East Opening)—No. 109 on Map II.

On south side of Emory Run, 0.1 mile south of Emoryville Station; **Elk Lick Coal**; elevation, 2080′ B.

		Ft.	In.
1. Shale, dark			
2. **Coal**, very bony	0′ 11″		
3. **Coal**, very hard	0 8		
4. Slate, bony	0 8		
5. **Coal**, soft	2 2		
6. Bone	0 4	4	9
7. Shale, pavement			

"Principal office, Emoryville, W. Va.; coal leased from W. Va. Central and Pittsburgh Railway; daily capacity, (still in development stage); greatest rise, south; Arthur Jack, Mine Foreman, authority for mine data; sample (No. 518R) collected from Nos. 3 and 5 of section in Main Heading, for composition of which see **Mine No. 109** in the Table of Coal Analyses at the end of this Chapter."

Bakertown Coal Company Mine (West Opening)—No. 110 on Map II.

On east side of Abram Creek, 0.3 mile southwest of Emoryville Station; **Elk Lick Coal**; elevation, 2095′ B.

		Ft.	In.
Shale, dark			
Coal	0′ 10″		
Shale, dark	0 10		
Coal	2 3		
Shale, bony	0 2		
Coal	0 6	4	7
Shale, pavement			

For mine data see No. 109.

The following is a wagon mine operated by the same company for local fuel:

Bakertown Coal Company Farm Mine—No. 111 on Map II.

On branch of Abram Creek, 0.5 mile southwest of Emoryville Station; **Elk Lick Coal**; elevation, 2135′ B.

			Ft.	In.
Shale, dark				
Coal, bony	0′	7″		
Slate, dark	0	6		
Coal, soft	2	0		
Slate, black	0	1		
Coal, medium-hard	0	8	3	10
Shale, pavement				

Coal Prospect No. 112 on Map II, located on the west side of Abram Creek 0.9 mile southwest of Emoryville Station, at elevation 2195′ B., had fallen shut, no report being obtained as to its thickness. The following is a commercial mine that was temporarily inactive when visited:

Love Coal Company Mine—No. 113 on Map II.

On east side of Abram Creek, 0.2 mile northwest of Wabash; **Elk Lick Coal**; elevation, 2200′ B.

			Ft.	In.
1. Shale, dark				
2. Slate, cannel			1	9
3. **Coal**, soft	2′	0″		
4. Slate, bony	0	2		
5. **Coal**, hard	0	6	2	8
6. Shale, pavement				

"Principal office, Emoryville, W. Va.; coal leased from Jo L. Keener; daily capacity, 50 tons; 15 miners and 3 laborers employed; mule haulage; coal shipped east for steam fuel; greatest rise, southeast; F. H. Love, General Manager, authority for mine data; sample (No. 523R) collected from Nos. 3 and 5 of section in Second Right, for composition of which see **Mine No. 113** in the Table of Coal Analyses at the end of this Chapter."

Coal Mine No. 114 on Map II, located on the east side of Abram Creek 0.2 mile southwest of Wabash, at an elevation of 2215′ B., was abandoned and fallen shut; also **Coal Mine No. 115 on Map II,** located on the east side of Abram Creek 0.5 mile southwest of Wabash, at an elevation of 2225′ B., was abandoned and closed. Both of these were former commercial mines.

Farther up the Potomac in Mineral County no other openings in the Elk Lick Coal were noted, but at **Coal Exposure No. 116 on Map II,** located on the south side of North Branch of Potomac 0.5 mile southwest of Gleason, at an elevation of 2465′ B., its blossom is exposed at a spring, as recorded in the Gleason Section, page 170.

Elk Lick ("Barton", "Four-foot") Coal, Union District, Grant County.

In Union District, Grant County, the Elk Lick Coal has not been commercially mined but it has been used as local domestic fuel in somewhat restricted areas. In the region adjacent to the Mineral County Line it is a fairly persistent coal but farther west toward Tucker County various bore holes indicate that it is not thick enough for mining.

On the east side of Abram Creek, 1.5 miles southwest of Wabash, the coal was once opened at **Farm Mine No. 117 on Map IV,** at elevation 2410′ B., but the place had fallen shut and no report was obtained relative to its thickness.

Coal Exposure No. 118 on Map IV, located in the road on a branch of Glade Run of Abram Creek, at elevation 2510′ B., shows a heavy blossom of this coal.

The two following sections were obtained at farm mines:

Lurana Duling Coal Opening—No. 119 on Map IV.

On north side of Glade Run of Abram Creek, 0.7 mile southwest of Hartmansville; **Elk Lick Coal**; elevation, 2595′ B.

			Ft.	In.
Shale, dark				
Coal, bony	1′	1″		
Coal, soft	1	1½		
Slate, black	0	0½		
Coal, soft	2	2	4	5
Bony pavement				

Jacob Hawk Coal Opening—No. 120 on Map IV.

On branch of Abram Creek, 0.3 mile west of Mt. Pisgah Church; **Elk Lick Coal**; elevation, 2710′ B.

			Ft.	In.
Shale, dark				
Coal, bony	1′	3″		
Coal, soft	2	3	3	6
Shale, pavement				

At the **William Aronhalt Exposure (No. 121 on Map IV),** located in a field on the west side of Abram Creek 2.2 miles southwest of Wabash, a slight blossom of the coal is visible at elevation 2440′ B. The following is a farm mine, opened late in the season of 1921:

James Shillingburg Farm Mine—No. 122 on Map IV.

On Wyckoff Run of Johnnycake Run of Abram Creek, 2.1 miles northeast of Mount Storm; **Elk Lick Coal**; elevation, 2425′ B.

			Ft.	In.
1. Shale, dark				
2. **Coal**	0′	9″		
3. Slate, bony	1	8		
4. **Coal**	0	2		
5. Shale, dark	3	0		
6. Slate, bony	0	8		
7. **Coal**, soft	2	1	8	4
8. Slate, dark, pavement				

A sample (No. 576R) was collected from No. 7 of section, the composition of which is published under **Mine No. 122** in the Table of Coal Analyses at the end of this Chapter.

In the valley of Stony River some openings and exposures are available at scattered points. At **Coal Exposure No. 124 on Map IV**, located east of the river and along the Northwestern Pike 0.6 mile southwest of Mount Storm, the blossom of the coal is visible at elevation 2730′ B.; and at **Coal Exposure No. 125 on Map IV**, located along the same road 0.3 mile southwest of Mount Storm, it is again visible at elevation 2770′ B. The three following farm mines are located in the region south and southwest of Mount Storm:

Mrs. M. M. Endler Farm Mine—No. 125 on Map IV.

On Mill Run of Stony River, 1.2 miles south of Mount Storm; **Elk Lick Coal**; elevation, 2755′ B.

			Ft.	In.
Shale, dark				
Coal, bony	0′	7″		
Coal, medium-hard	0	4		
Coal, bony	0	8		
Coal, soft	2	9	4	4
Pavement (?)				

At the above mine, which has a southward dip, the bottom foot was covered by water, making the measurement and character of this portion of the bed uncertain.

Alkire Brothers Farm Mine—No. 126 on Map IV.

On west side of Stony River, 2 miles southwest of Mount Storm; **Elk Lick Coal**; elevation, 2730′ B.

			Ft.	In.
Shale, sandy				
Slate, black			1	0
Coal, soft	0′	8″		
Coal, bony	1	2		
Coal, soft	1	9	3	7
Shale, pavement				

J. J. Cosner Farm Mine—No. 127 on Map IV.

On east side of Stony River, 2.2 miles southwest of Mount Storm; **Elk Lick Coal**; elevation, 2755′ B.

			Ft.	In.
Shale, sandy, and slate, dark				
Coal, bony	0′	8″		
Coal, medium-hard	0	5		
Coal, bony	0	3		
Coal, soft	1	9	3	1
Shale, pavement, (gentle southward dip)				

Above the mouth of Stony River there are only a few exposures of the coal in the Potomac Valley. At **Coal Exposure No. 128 on Map IV,** located along the Northwestern Pike on the east side of Difficult Creek, there is a big blossom visible at 2765′ B. that appears to be the Elk Lick.

At **Coal Exposure No. 129 on Map IV,** located on the west side of Buffalo Creek 0.3 mile south of Bayard, there is a thickness of two feet along a private road at elevation 2625′ B., as recorded in the Bayard Section, page 179.

The **William McGinnis Farm Mine (No. 130 on Map IV),** located in Garrett County, Maryland, on a branch of North Branch of Potomac River, 0.3 mile northwest of Bayard, at elevation 2480′ B., had fallen shut, its thickness being reported as 2 to 3 feet.

Coal Prospect No. 131 on Map IV, located in Garrett County, Maryland, on the west side of North Branch of Potomac River 0.2 mile southwest of Wilson, at elevation 2550′ B., had fallen shut, its thickness being reported by Burt Wilson as $1\frac{1}{2}$ to 2 feet.

Quantity of Elk Lick ("Barton", "Four-foot") Coal Available.

The following table, compiled by Tucker from a planimetric measurement of the outcrops on Maps II and IV, shows the probable amount of Elk Lick Coal in the two counties, the thickness and estimate for Union District being applicable only to that portion indicated by Figure 17 as having minable coal:

Probable Amount of Elk Lick ("Barton," "Four-foot") Coal.

Districts.	Thickness of Coal Assumed. Feet.	Square Miles.	Acres.	Cubic Feet of Coal.	Short Tons of Coal.
Mineral County:					
Piedmont	2	4.10	2,624.0	228,602,880	9,144,115
Elk	2	27.00	17,280.0	1,505,433,600	60,217,344
Totals		31.10	19,904.0	1,734,036,480	69,361,459
Grant County:					
Union	2	23.10	14,784.0	1,287,982,080	51,519,283
Gr. T'ls for Area		54.20	34,688.0	3,022,018,560	120,880,742

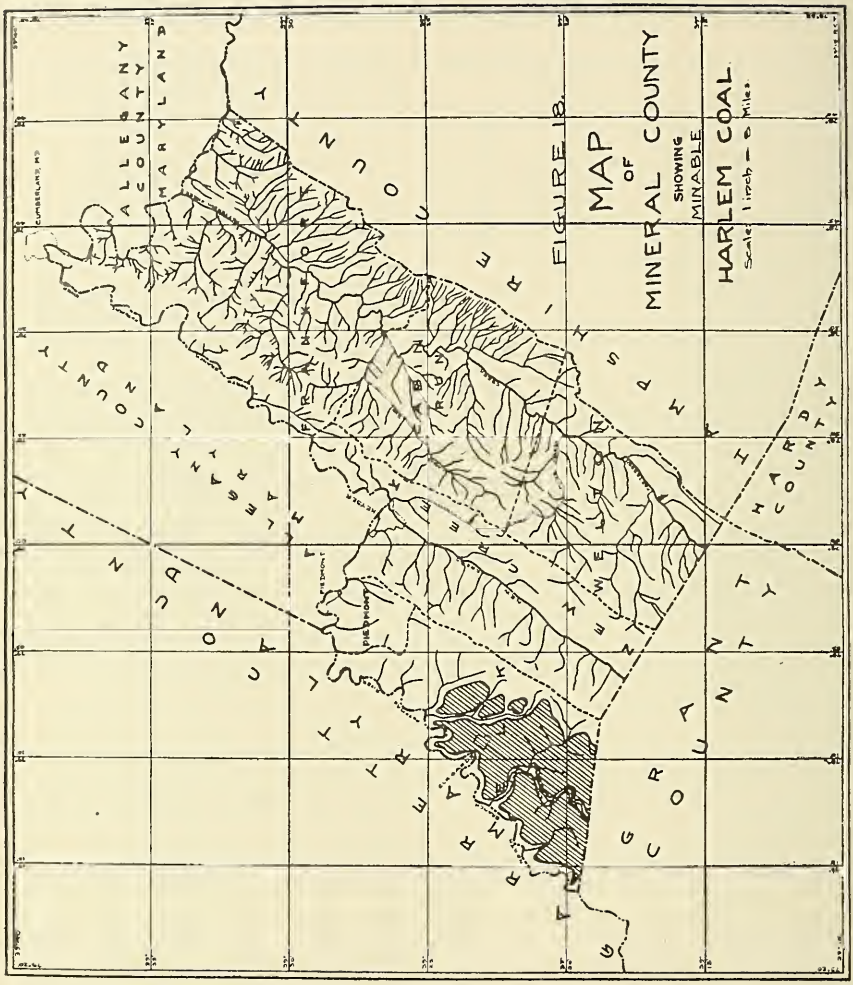
In the above table an allowance has been made in the thickness column for the impurities of the bed and its local thinning or absence in certain localities within the boundaries indicated on Figures 16 and 17. No figures are available to show the exact amount of coal which has been mined but it is probable that perhaps 10 per cent. of the original area has been worked over. On such a basis the present available area would be reduced to 31,219.2 acres and the quantity to 108,792,668 short tons.

HARLEM COAL.

The Harlem Coal, previously described in Chapter VII, pages 221-2, and coming about 100 feet below the Elk Lick seam, has not been mined commercially at any point in either county and has been prospected only at infrequent localities. In certain portions of both counties, however, it has a thickness of two feet, or slightly less, and being a pure clean coal, without partings, there is little doubt that its exploitation will be attempted. In parts of both counties it is apparently much too thin for mining but its blossom may usually be found by patient search, indicating the general continuity of its bed. Its outcrop is delineated on Maps II and IV in those areas where it is believed to be of some value, and Figures 18 and 19 indicate in more compact form its minable extent.

Harlem Coal, Piedmont, District, Mineral County.

In Piedmont District there is no evidence that the Harlem Coal is of minable thickness at any point but its ex-


ALLEGANY COUNTY
MARYLAND
GARRETT COUNTY
HARFORD COUNTY
GRANT COUNTY
FIGURE 18.
MAP
OF
MINERAL COUNTY
SHOWING
MINABLE
HARLEM COAL
Scale 1 inch = 6 Miles.

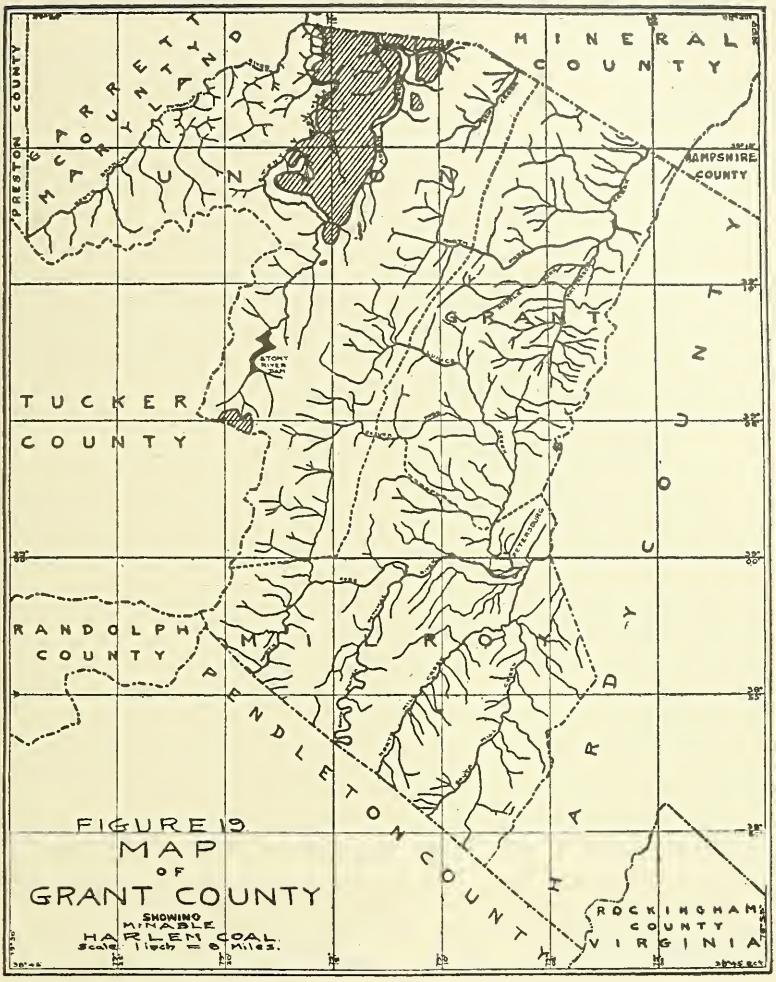


FIGURE 19
MAP
OF
GRANT COUNTY

posures are of scientific interest because of the fact that it directly underlies the fossiliferous Ames Shale.

In Allegany County, Maryland, its blossom is visible in Franklin Hill 0.5 mile north of Luke, at elevation 1380′ B., as noted in the Luke Section, page 158.

At **Coal Exposure No. 144 on Map II**, located in the mountain road east of Montgomery Run and 1.1 miles southwest of Piedmont, its blossom is visible at elevation 1603′ B., as recorded in the Piedmont Section, page 156.

At **the Charles Tasker Prospect (No. 145 on Map II)**, located on the north side of Piney Swamp Run 1 mile northeast of Tasker School, at elevation 2390′ B., it was once opened but the place had fallen shut and its thickness was not learned. Its identification here is positive because of the presence of the Ames fossils in the roof shales.

Harlem Coal, Elk District, Mineral County.

In the northeastern end of Elk District the Harlem Coal appears to be too thin for mining but in the drainage area of Deep Run and southwestward toward the Grant County Line, as shown by Figure 18, it is thicker and more uniform.

At **Coal Exposure No. 146 on Map II**, located in the road north of Howell Run 0.3 mile southeast of Shaw, there is a heavy blossom visible at elevation 1515′ B., as recorded in the Howell Run Section, page 166; and at **Coal Exposure No. 147 on Map II**, located along the road ascending the hill south of North Branch of Potomac and 0.4 mile southwest of Shaw, there is 1½ feet of it visible at elevation 1565′ B., as indicated by the Shaw Section, page 167.

The following is a prospect recently made on Deep Run:

Jaffy Coal Mining Company Prospect—No. 148 on Map II.

On the west side of Deep Run, 0.5 mile north of Nethken; **Harlem Coal**; elevation, 1670′ B.

	Ft.	In.
Shale, dark-green, fossiliferous, **Ames**		
Coal	2	3
Shale, pavement		

Farther south its blossom is visible again at **Coal Exposure No. 149 on Map II**, in the road ascending the hill west of Deep Run and 0.7 mile east of Elk Garden, at elevation 1795′ B., coming just under the Ames fossils. The following opening is in the same neighborhood:

Jack Jones Prospect—No. 150 on Map II.

On west side of Deep Run, 1.2 miles southeast of Elk Garden; Harlem Coal; elevation, 1900′ B.

	Ft.	In.
1. Shale, dark-green, fossiliferous, Ames	6	0
2. Coal, soft	2	1
3. Shale, pavement		

A sample (No. 512R) was collected from No. 2 of section, the composition of which is published under **Mine No. 150** in the Table of Coal Analyses at the end of this Chapter. This sample came from a prospect which had been driven just barely under cover but the analysis shows a coal that is somewhat better than the average of all mines sampled in the Elk Lick Coal, the figures for the Harlem being more favorable in respect to the prosphorus, ash, sulphur, and B. T. U. It is a softer coal than the Elk Lick, however, and slightly higher in volatile matter and for both reasons might not prove so satisfactory for domestic fuel, since there would be more breakage in shipment and more smoke from consumption.

At the **John Kitzmiller Prospect (No. 151 on Map II),** located on the south side of North Branch of Potomac River 0.3 mile southeast of Blaine, at elevation 2010′ B., there was 0′ 9″ of coal visible in the bottom of a spring where it was impossible to face up the seam. Its stratigraphic relationships are shown in the Elk Garden Section, page 169.

The **Mapleville Coal Company Prospect (No. 152 on Map II),** on an eastern branch of Abram Creek 0.8 mile east of Oakmont, at elevation 2025′ B., had fallen shut, its thickness not being learned.

At **Coal Exposure No. 153 on Map II,** located in a mountain road on the east side of North Branch of Potomac River 0.7 mile east of Schell, at elevation 2515′ B., only the blossom of the coal was visible.

Harlem Coal, Union District, Grant County.

In Union District the Harlem Coal appears to have value in most of the region of its occurrence east of Stony River, but west of this stream neither outcrops nor borings reveal coal of minable thickness, as indicated by Figure 19. The three following exposures and prospects are in the Bismarck settlement:

Coal Exposure—No. 154 on Map IV.

On the west side of Abram Creek, 1.5 miles northeast of Bismarck; **Harlem Coal**; elevation, 2845′ B.

	Ft.	In.
Shale, dark-green, marine fossils, **Ames**	25	0
Coal, Harlem	2	0
Shale, variegated, **Pittsburgh Reds**	40	0

Elmer Kuhn Prospect—No. 155 on Map IV.

On the west side of Eye Run of Stony River, 1.2 miles northwest of Mount Storm; **Harlem Coal**; elevation, 2605′ B.

	Ft.	In.
Sandstone, flaggy		
Shale, dark, plant fossils	4	0
Coal	1	9
Shale, pavement		

D. F. Cosner Farm Mine—No. 156 on Map IV.

On the west side of Mill Run of Stony River, 1.2 miles northwest of Bismarck; **Harlem Coal**; elevation, 2820′ B.

	Ft.	In.
Shale, dark, sandy, **Ames**		
Coal, thickness concealed, about	2	0

The above opening had fallen shut but the mine props were about two feet long, indicating a probable equivalent thickness of coal.

The **Silas Rinker Prospect (No. 157 on Map IV)**, located on the east side of Stony River 1.2 miles northeast of the mouth of Helmick Run, at elevation 3235′ B., had fallen shut, no report being obtained as to its thickness. The following prospect had fallen shut, Otto Sittig, guide, being authority for the thickness of the coal:

Welton Tract Prospect—No. 158 on Map IV.

On the east side of Stony River, 0.5 mile east of the mouth of Helmick Run; **Harlem Coal**; elevation, 3350′ B.

	Ft.	In.
Shale, dark-green, with fossil fragments, **Ames**		
Slate, black		
Coal, reported	1	6
Concealed and bright-red shale, **Pittsburgh Reds**		

At **Coal Exposure No. 159 on Map IV,** in the Northwestern Pike west of Difficult Creek and 1.7 miles southeast of Gormania, at elevation 2680′ B., only the blossom of the coal was visible, there being marine fossils in the roof shales; and at **Coal Exposure No. 160 on Map IV,** along the same

Photo by E. E. HARRIS.

PLATE XXXI.—Exposure of Fossil Ore Horizon of Clinton Series on Lunice Creek 1 mile northwest of Maysville. See description of John Trenton Exposure. Two-foot rule is on upper bench of ore (No. 2 of section) and hammer is on lower bench (No. 8). Niagara Limestone (No. 1) is visible above rule.

road, 0.6 mile east of Gormania, at elevation 2665′ B., there is nothing but a blossom exposed. The following exposure is located in Garrett County, Maryland, 0.7 mile from the West Virginia Line:

James Chisholm Coal Exposure—No. 161 on Map IV.

Garrett County, Maryland, in the bed of Glade Run of North Branch of Potomac River, 1.5 miles northeast of Gorman; **Harlem Coal**; elevation, 2440′ B.

	Ft	In.
Shale, dark, with marine fossils, **Ames Coal**	1	10
Shale, dark, hard		

Coal Prospect No. 162 on Map IV, located on the south side of North Branch of Potomac River 0.3 mile west of Bayard, at elevation 2450′ B., had fallen shut, no report being obtained about its thickness.

Quantity of Harlem Coal Available.

The following table, compiled by Tucker from a planimetric measurement of the outcrop on Maps II and IV, shows the probable amount of Harlem Coal available in the regions indicated on Figures 18 and 19:

Probable Amount of Harlem Coal.

Districts.	Thickness of Coal Assumed. Feet.	Square Miles.	Acres.	Cubic Feet of Coal.	Short Tons of Coal.
Mineral County:					
Elk	1½	26.70	17,088.0	1,116,529,920	44,661,197
Grant County:					
Union	1½	27.25	17,440.0	1,139,529,600	45,581,184
Gr. T'tls for Area		53.95	34,528.0	2,256,059,520	90,242,381

UPPER BAKERSTOWN COAL.

The Upper Bakerstown Coal, previously described in Chapter VII, page 223, and coming 30 to 50 feet above the Bakerstown ("Thomas") Coal, is of commercial thickness in portions of Piedmont and Elk Districts, Mineral County, northeast of Abram Creek. Southwest of Abram Creek in

this county it becomes thin and uncertain and farther up North Branch of Potomac River in Union District, Grant County, it is seldom found and disappears almost completely on the extreme headwaters of the river. In its minable region it usually varies from 3 to 5 feet in thickness, there being several streaks of shale or bone which reduce its value. It has been mined at a few small operations but these are not at present active. Owing to its position so close above the Bakerstown ("Thomas") Coal its outcrop is not shown on Map II but Figure 20 indicates the region in which it is of general value, although more particular reference should be made to local sections for more precise data.

Upper Bakerstown Coal, Piedmont District, Mineral County.

In Piedmont District the Upper Bakerstown Coal has not been commercially mined and has been prospected at only a few points, but on the north side of the Potomac River in Allegany County, Maryland, it has been opened at several points along the side of Franklin Hill between Westernport and Luke, having been mostly hauled by wagon into the local market and most of the entries now being abandoned. The following is one of them:

Coal Mine—No. 163 on Map II.

Allegany County, Maryland, on Franklin Hill, 0.4 mile west of the mouth of Georges Creek; **Upper Bakerstown Coal**; elevation, 1280′ B.

			Ft.	In.
Sandstone, massive, **Saltsburg**			30	0
Shale, sandy, 1′ to			5	0
Coal, soft	2′	3″		
Shale, gray	0	6		
Coal, soft	1	9		
Slate, dark	0	1		
Coal	0	11	5	6
Shale, dark, pavement				

The **West Virginia Pulp & Paper Company Mine (No. 164 on Map II)**, located in Allegany County, Maryland, on Franklin Hill 0.5 mile north of Luke, at elevation 1300′ B., and at present inactive, measured 4′ 5″, with a central shale parting, as recorded in the Luke Section, page 158.

Farm Mine No. 165 on Map II, located on the south side of North Branch of Potomac River, 0.3 mile southeast of Luke, at elevation 1465′ B., had fallen shut, no report on its thickness being obtained. At **Coal Exposure No. 166 on Map II**, located along the mountain road south of North Branch of Potomac River 0.3 mile south of Luke, at elevation 1495′ B., there is a two-foot blossom of this coal visible, as recorded in the Piedmont Section, page 156.

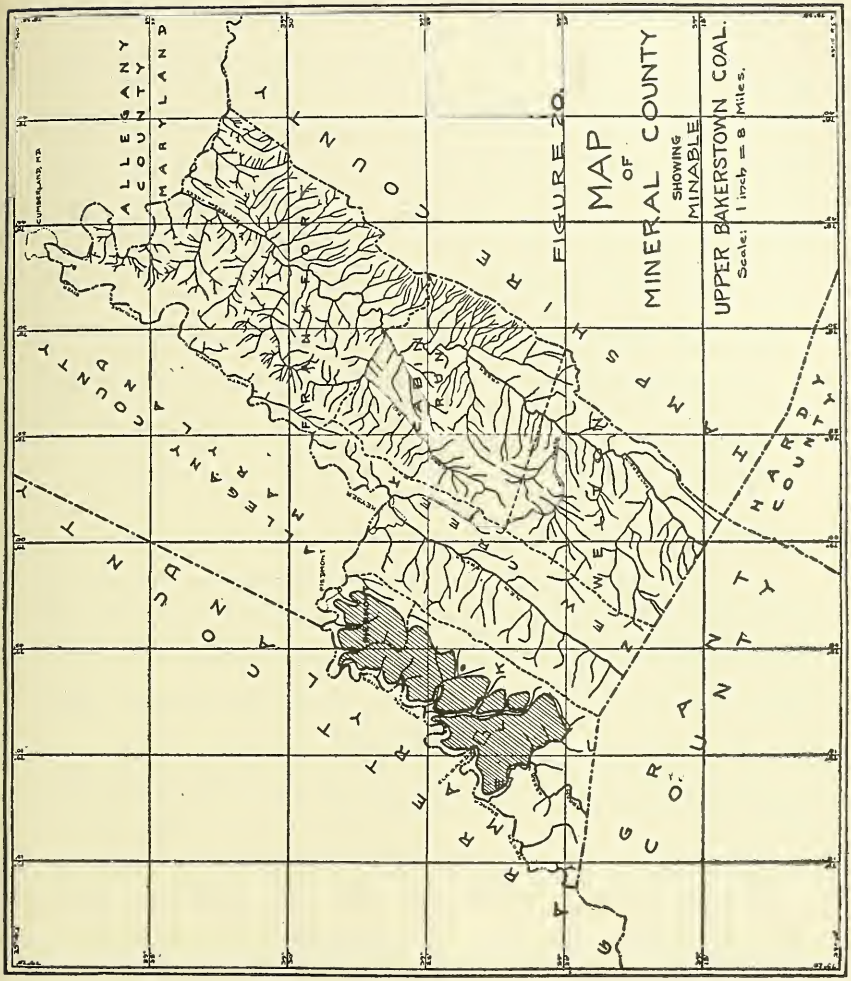


FIGURE 20.
MAP
OF
MINERAL COUNTY
SHOWING
MINABLE
UPPER BAKERSTOWN COAL.
Scale: 1 inch = 8 Miles.
ALLEGANY COUNTY
MARYLAND
GARRETT COUNTY
PRESTON COUNTY
TUCKER COUNTY
RANDOLPH COUNTY
HARDY COUNTY
GRANT COUNTY
HAMPSHIRE COUNTY
JANNETTA
CUMBERLAND
PATTERSON CREEK
NEW CREEK
KEYSER
WILEY FORD
BLOOMERY
PATTERSON CREEK MTN.
NEW CREEK MTN.
KNOBLEY MTN.
SAVAGE MTN.
BIG SPRING
WARDENSVILLE
MOUNT STORM
BIG RUN
BIG SPRING RUN
NEW CREEK RUN
PATTERSON CREEK
SAVAGE RIVER
NORTH BRANCH POTOMAC RIVER

Upper Bakerstown Coal, Elk District, Mineral County.

In Elk District the Upper Bakerstown Coal has been prospected at several points and was once mined commercially on Deep Run near Nethken.

The **Masteller Coal Company Prospect (No. 167 on Map II)**, located on the west side of Piney Swamp Run 0.8 mile southwest of Hampshire, at elevation 1295′ B., had fallen shut, its thickness not being learned. Its relationship to other coals is indicated in the Hampshire Section, page 163.

The following prospect had fallen shut, the section being reported by John Fulton:

Kalbaugh Coal Company Prospect—No. 168 on Map II.

On Lynnwood Run of North Branch of Potomac River, 0.8 mile southeast of Barnum; **Upper Bakerstown Coal**; elevation, 1390′ B.

			Ft.	In.
Slate				
Bone coal, reported	0′	4″		
Coal,. reported	4	3	4	7
Fire clay				

At **Coal Exposure No. 169 on Map II**, on the east side of Deep Run 1 mile south of Shaw, only the blossom of the coal is visible, its elevation being 1540′ B. The following is an abandoned commercial mine on the same stream:

Deep Run Big Vein Coal Company Mine (Abandoned)—No. 170 on Map II.

On the east side of Deep Run, 0.3 mile northeast of Nethken; **Upper Bakerstown Coal**; elevation, 1615′ B.

			Ft.	In.
Shale, dark				
Coal, soft	0′	6″		
Coal, bony	1	4		
Coal, soft	0	5		
Coal, bony	0	3		
Coal, soft	2	0	4	6
Shale, pavement				

The **Deep Run Big Vein Coal Company Prospect (No. 171 on Map II)**, located on the west side of Deep Run 0.1 mile north of Nethken, at elevation 1605′ B., had fallen shut, its thickness not being learned; and **Coal Prospect No. 172 on Map II**, on the same side of Deep Run, 0.4 mile southwest of Nethken, at elevation 1710′ B., had also fallen shut, no report being obtained as to its thickness.

The **John Kitzmiller Exposure (No. 173 on Map II)**, located in a fresh highway cut on the south side of North

Branch of Potomac River 0.2 mile southeast of Blaine, at elevation 1915′ B., exhibits a thickness of 5′ 0″, with a central parting, as detailed in the Elk Garden Section, page 169.

The **Mapleville Coal Company Mine (No. 174 on Map II),** located on an eastern branch of Abram Creek 0.8 mile east of Oakmont, at elevation 1945′ B., had fallen shut, its thickness being reported as 1′ 6″ by O. D. Harris, General Manager. A small amount of commercial coal was shipped from this opening.

The following is a farm mine located high up against the Allegheny Front and near the line where the coal overshoots the mountain on the southeastward rise of the rocks:

A. C. Dixon Farm Mine—No. 175 on Map II.

On a branch of Emory Run of Abram Creek, 0.9 mile southeast of Sulphur City; **Upper Bakerstown Coal**; elevation, 2720′ B.

			Ft.	In.
Shale, dark				
Coal, bony	0′	3″		
Coal, soft	1	1		
Bone	0	8		
Shale, dark	0	10		
Coal	2	0	4	10
Shale, pavement				

At **Coal Exposure No. 176 on Map II,** in a mountain road on the east side of North Branch of Potomac River 0.6 mile east of Schell, at elevation 2420′ B., only a light blossom of the coal is visible, as recorded in the Schell Section, page 173.

At the **Hubbard Coal Mining Company Mine (No. 177 on Map II),** located in Garrett County, Maryland, on the north side of North Branch of Potomac River, 0.4 mile north of Hubbard, at elevation 2460′ B., the coal was once mined commercially but is now inactive. A section near the mouth of the old entry shows a total thickness of 3′ 10″, with a central shale parting, as detailed in the Hubbard Section, page 171.

Upper Bakerstown Coal, Union District, Grant County.

In Union District only a few exposures and prospects in the Upper Bakerstown Coal were noted, all of these indicating a coal that is too thin for mining, while toward the headwaters of the Potomac bore holes do not record good coal at this horizon.

The **W. W. Kitzmiller Exposure (No. 178 on Map IV),** located on Glade Run of Abram Creek 1.6 miles southwest of Hartmansville, at elevation 2369′ B., shows only 1 foot of bony coal. Here the coal is only 10 feet above the top, or 14 feet above the base, of the Bakerstown ("Thomas") Coal which is opened at the same point.

At **Coal Exposure No. 179 on Map IV,** located in the road west of Abram Creek 1.4 miles northeast of Bismarck, at elevation 2790′ B., only a blossom of the coal is visible.

The **S. H. Jordan Prospect (No. 180 on Map IV),** located on the south side of North Branch of Potomac River 0.8 mile northeast of Gormania, at elevation 2550′ B., had fallen shut. According to Mr. Jordan the coal measured 0′ 10″ at outcrop but thinned out completely under the hill.

On the West Virginia side of the Potomac a favorable opportunity for sampling the Upper Bakerstown Coal was not found, since all the prospects examined were near the surface or had been long exposed to oxidizing agencies. The following analysis of this coal, however, is taken from the separate sheet of analyses which accompanies the recently published Volume XI of the Maryland Survey, the sample having been taken by W. A. Baker, Jr., from a new opening in this coal on the west side of Koontz Run, Garrett County, Maryland, 3 miles northwest of Lonaconing, at the face of the Main Heading of the Maryland Coal Company Mine, 350 feet under cover. The sample was analyzed by A. C. Fieldner of the U. S. Bureau of Mines:

Sample of Upper Bakerstown Coal, Allegany County, Maryland

Proximate Analysis.

	Condition of Sample			
	Air-dried.	As received.	Moisture-free.	Moisture- and ash-free.
Moisture	0.60	1.40		
Volatile Matter	17.63	17.49	17.74	22.76
Fixed Carbon	59.19	58.71	59.54	77.04
Ash	22.58	22.40	22.72	
Ultimate Analysis.				
Hydrogen	3.64	3.70	3.59	4.65
Carbon	66.57	66.04	66.98	86.67
Nitrogen	1.18	1.17	1.19	1.54
Oxygen	2.84	3.53	2.32	3.00
Sulphur	3.19	3.16	3.20	4.14
Ash	22.58	22.40	22.72	
B. T. U. Determined	11,698	11,605	11,770	15,230

The above analysis shows an unusual amount of ash, indicating that some bony matter may have been included in the sample, but no section of the mine is published by which this may be known.

Quantity of Upper Bakerstown Coal Available.

The following table, compiled by Tucker from a planimetric measurement of the outcrop, shows the probable amount of Upper Bakerstown Coal in that portion of Mineral County indicated by Figure 20 as containing it in minable thickness:

Probable Amount of Upper Bakerstown Coal.

Districts.	Thickness of Coal Assumed. Feet.	Square Miles.	Acres.	Cubic Feet of Coal.	Short Tons of Coal.
Mineral County:					
Piedmont	3	5.35	3,424.0	447,448,320	17,897,933
Elk	3	22.00	14,080.0	1,839,974,400	73,598,976
Totals		27.35	17,504.0	2,287,422,720	91,496,909

BAKERSTOWN ("THOMAS") COAL.

The Bakerstown ("Thomas") Coal, previously described in Chapter VII, pages 224-5, is of minable thickness generally, except for small areas of local thinning, throughout the portions of both Mineral and Grant Counties where its horizon occurs, being from 3 to 5 feet in thickness but often containing streaks of shale or bone that increase the cost of mining. For many years this bed has been commercially mined in the Potomac Valley as the "Freeport Coal," but the error in calling it by this name has already been pointed out. Its outcrop is delineated on Maps II and IV and on Figures 21 and 22 its areal extent in the two counties is shown in more concise form.

Bakerstown ("Thomas") Coal, Piedmont District, Mineral County.

In Piedmont District the Bakerstown Coal has not been mined commercially but prospects have been made at several points and it has also been opened on the Maryland side of the Potomac. These exposures indicate that the coal is not

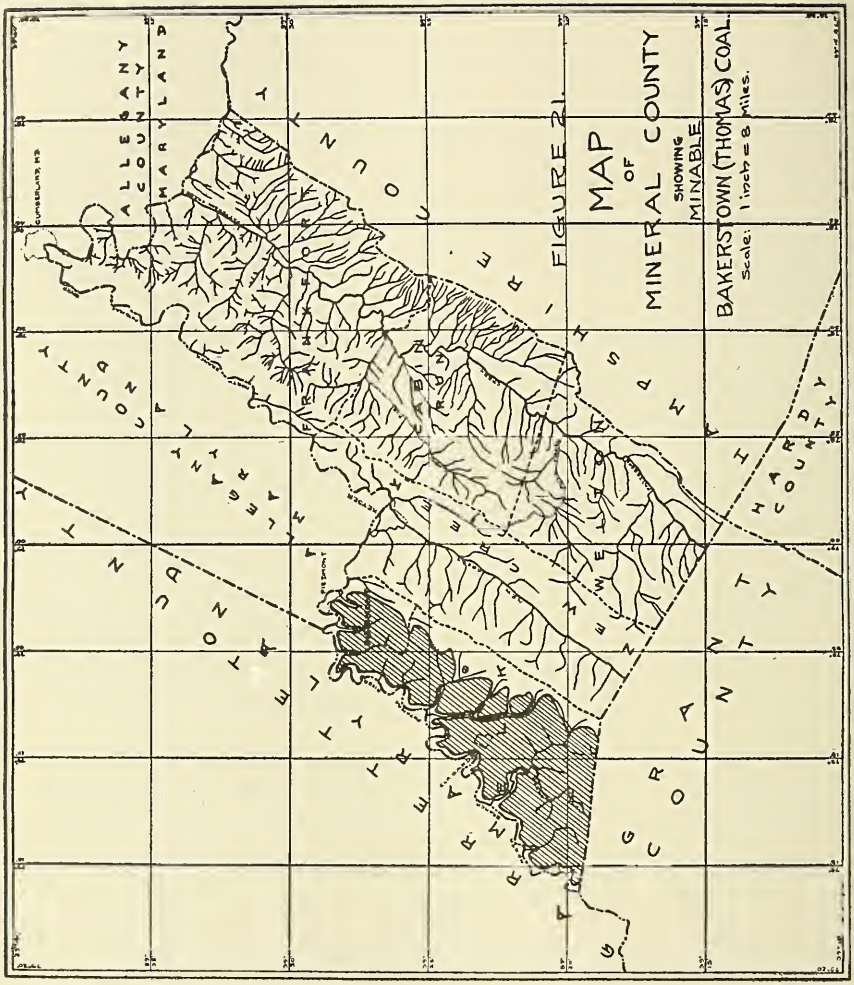
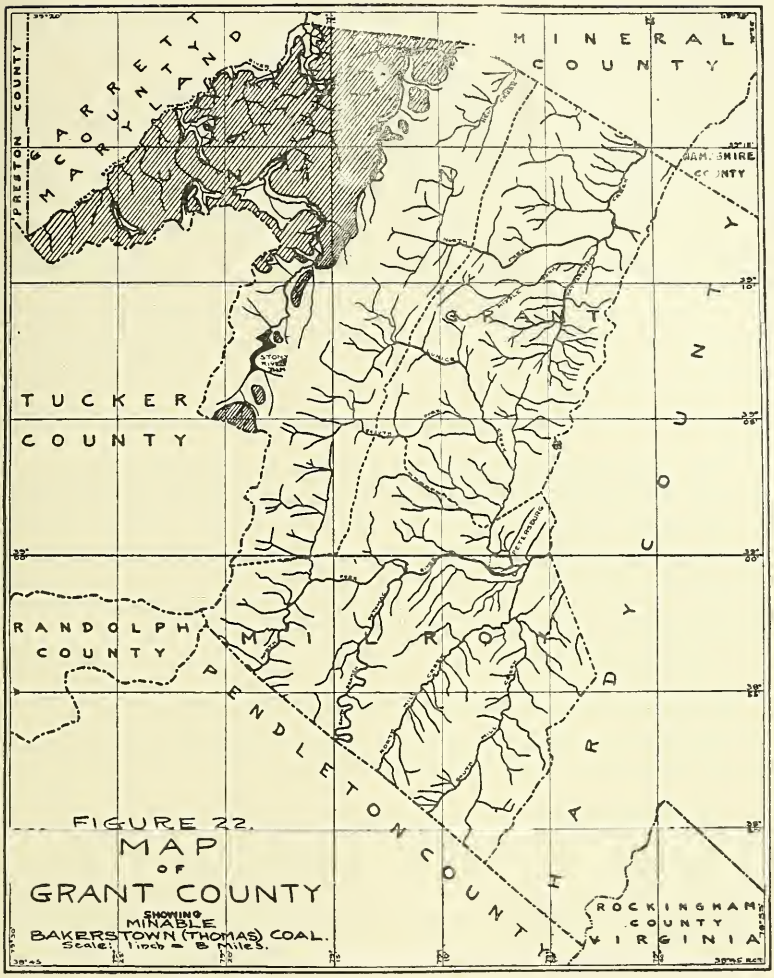

ALLEGANY COUNTY
MARYLAND
GARRETT COUNTY
PRESTON COUNTY
TUCKER COUNTY
RANDOLPH COUNTY
HARDY COUNTY
GRANT COUNTY
MAP
OF
MINERAL COUNTY
SHOWING
MINABLE
BAKERSTOWN (THOMAS) COAL.
Scale: 1 inch = 8 miles.

FIGURE 21.


PRESTON COUNTY
MONONGALIA COUNTY
MINERAL COUNTY
GRANT COUNTY
TUCKER COUNTY
RANDOLPH COUNTY
PENDLETON COUNTY
HARDY COUNTY
ROCKINGHAM COUNTY VIRGINIA
STONY RIVER
FIGURE 22.
MAP
OF
GRANT COUNTY
SHOWING
MINABLE
BAKERSTOWN (THOMAS) COAL.
Scale: 1 inch = 8 Miles.

so thick as found at points farther up the Potomac but that it may eventually be mined.

The **Hoffa-Martin Coal Company Prospect (No. 181 on Map II)**, located on the east side of Slaughterhouse Run 1.2 miles southeast of Piedmont, at elevation 1655′ B., had fallen shut, no report being obtained about its thickness.

The **West Virginia Pulp & Paper Company Mine (No. 182 on Map II)**, located in Allegany County, Maryland, on Franklin Hill 0.5 mile north of Luke, at elevation 1282′ B., measured 3′ 4″ of which the upper 8 inches is bony coal, as detailed in the Luke Section, page 158.

Coal Prospect No. 183 on Map II, in Garrett County, Maryland, on the south side of Savage River 1.2 miles northwest of Bloomington, at elevation 1390′ B., had fallen shut, no report being obtained concerning its thickness. The stratigraphic association is noted in the Bloomington Section, page 160.

At **Coal Exposure No. 184 on Map II,** on the south side of North Branch of Potomac River 0.3 mile southeast of Luke, at elevation 1415′ B., only the blossom of the coal is visible, as recorded in the Piedmont Section, page 156; and at **Coal Exposure No. 185 on Map II,** on the south side of North Branch of Potomac River 0.3 mile south of Luke, at elevation 1453′ B., only the blossom is visible.

The following is a recent prospect on Piney Swamp Run:

Masteller Coal Company Prospect—No. 186 on Map II.

On the east side of Piney Swamp Run, 1.2 miles south of Hampshire; **Bakerstown Coal**; elevation, 1360′ B.

			Ft.	In.
Shale, sandy				
Coal	0′	8″		
Bone	0	1		
Coal, soft	1	5		
Bone	0	3		
Coal, soft	1	3	3	8
Shale, pavement				

The **Charles Tasker Prospect (No. 187 on Map II)**, on the north side of Piney Swamp Run 1 mile northeast of Tasker School, at elevation 2330′ B., had fallen shut, being reported as 2 feet thick by the owner.

Bakerstown ("Thomas") Coal, Elk District, Mineral County.

In Elk District the Bakerstown Coal has been mined extensively, the major portion of the output going eastward for steam and domestic purposes. In general the seam is thick enough to permit the use of standard mining equipment so

that moderately low costs can be maintained, but in limited local areas the coal thins down or possibly disappears.

The following farm mine section was secured well up toward the top of the Allegheny Front where the southeastward rise of the rocks is quite rapid:

George Tasker Farm Mine—No. 188 on Map II.

On the south side of Piney Swamp Run 0.8 mile northeast of Tasker School; **Bakerstown Coal**; elevation, 2450′ B.

			Ft.	In.
Sandstone				
Shale, dark, sandy			7	0
Coal	1′	6″		
Shale, dark	0	6		
Coal	1	9	3	9
Fire clay, pavement				

At the **Monroe Coal Mining Company Mine (No. 189 on Map II)**, in Garrett County, Maryland, on the west side of North Branch of Potomac River 0.2 mile west of Barnum, at elevation 1425′ B., the coal measured a total of 3′ 2″, being bony at the top as indicated in the Barnum Section, page 164. This opening is now abandoned.

The **Kalbaugh Coal Company Prospect (No. 190 on Map II)**, on Lynnwood Run of North Branch of Potomac River 0.8 mile southeast of Barnum, at elevation 1365′ B., had fallen shut, no report on its thickness being obtained.

The following opening is located on steeply dipping strata along the slope of the Allegheny Front:

Fred Schweinebart Farm Mine—No. 191 on Map II.

On Howell Run, 2 miles southeast of Shaw; **Bakerstown Coal**; elevation, 2075′ B.

			Ft.	In.
Shale, sandy				
Coal			0	6
Shale, sandy			5	0
Coal, soft	2′	0″		
Coal, bony	1	10	3	10
Shale, pavement				

The **Fred Schweinebart Prospect (No. 192 on Map II)**, located on Howell Run 2.3 miles southeast of Shaw, at elevation 2240′ B., had fallen shut, its thickness not being learned. The difference in elevation between these two openings indicates a rise of about 500 feet per mile in the strata.

The following is an outcrop in the public road near North Branch of Potomac River:

Coal Exposure—No. 193 on Map II.

On the east side of Deep Run, 0.2 mile south of Shaw; **Bakerstown Coal**; elevation, 1365′ B.

	Ft.	In.
Sandstone, massive		
Coal, visible, 3′ to	4	0
Shale, gray	10	0
Iron ore, **Pine Creek Limestone**	1	0

At **Farm Mine No. 194 on Map II**, on the west side of Deep Run 0.2 mile south of Shaw, at elevation 1390′ B., there is a total of 1′ 7″, with a central bony parting, as noted in the Shaw Section, page 167.

The following is a commercial mine in which operation had been temporarily suspended owing to a roll, or sudden thinning of the coal strata:

Jaffy Coal Mining Company (Jaffy Freeport) Mine—No. 195 on Map II.

On the west side of Deep Run, 0.5 mile north of Nethken; **Bakerstown Coal**; elevation, 1560′ B.

			Ft.	In.
1. Shale, dark				
2. **Coal**, soft	1′	0″		
3. Slate, dark, 0′ 6″ to	2	6		
4. **Coal**, soft	1	8	5	2
5. Shale, pavement				

"Principal office, Elk Garden, W. Va.; mine not in operation; sample (No. 506R) collected from Nos. 2 and 4 of section in First Left Heading, for composition of which see **Mine No. 195** in the Table of Coal Analyses at the end of this Chapter."

The **Jaffy Coal Mining Company Prospect (No. 196 on Map II)**, on the west side of Deep Run 0.2 mile north of Nethken, at elevation 1585′ B., had fallen shut, the coal being reported as 2 feet thick.

The following prospect was made at the writer's advice, both for the purpose of learning the thickness of the coal and also more particularly to determine the positive identity of the two Bakerstown Coals in the vicinity of Nethken, where the correlation of the abandoned mine (No. 170) in the Upper Bakerstown on the east side of the stream and Mine No. 195 in the Bakerstown on the west side had been in question. The base of Prospect No. 197 is 32 feet by hand-level measurement directly below the base of Mine No. 170, the presence of thick coal at that level confirming all identifications. Although sampled from apparently oxidized material only 25 feet under cover a good grade of coal is indicated. The section is as follows:

Deep Run Big Vein Coal Company Prospect—No. 197 on Map II.

On the east side of Deep Run, 0.3 mile north of Nethken; **Bakerstown Coal**; elevation, 1583′ B.

			Ft.	In.
1. Shale, dark				
2. **Coal**, soft	0′	8″		
3. Shale, dark	1	7		
4. Slate, bony	1	2		
5. **Coal**, soft	2	2	5	7
6. Shale, pavement				

A sample (No. 502R) was collected from No. 5 of section, the composition of which is published under **Mine No. 197** in the Table of Coal Analyses at the end of this Chapter.

The following is a prospect farther up Deep Run:

Davis Coal & Coke Company Prospect—No. 198 on Map II.

On east side of Deep Run, 0.4 mile south of Nethken; **Bakerstown Coal**; elevation, 1670′ B.

			Ft.	In.
Sandstone, shaly, **Thomas**			15	0
Shale, sandy			2	0
Coal	0′	4″		
Shale, dark	3	0		
Coal, soft	2	2	5	6
Shale, dark, sandy			6	0
Limestone, ferruginous, **Pine Creek?**			0	6
Shale, dark			2	0
Concealed, to Deep Run			10	0

The ferruginous limestone below the coal has much the appearance of the Pine Creek bed and the correlation so indicated may be correct, although no marine fossils could be found. It is possible that it is the Albright Limestone and that the Pine Creek belongs a few feet lower down near the bed of Deep Run. The identity of the coal is made certain by the presence of Prospect No. 172 in the Upper Bakerstown on the opposite side of the run.

The **Davis Coal & Coke Company Prospect (No. 199 on Map II)**, located on the south side of North Branch of Potomac River 1.3 miles southwest of Shaw, at elevation 1640′ B., had fallen shut, no report on its thickness being obtained. The provisional identification of this prospect is made on its elevation alone, since the wooded hillside was covered with so much debris that no other strata could be positively recognized.

The following mine, formerly known as the **Davis Coal and Coke Company No. 20,** was temporarily closed on account of the general shut-down. A section was measured near the mine mouth but owing to the absence of ventilation the owners considered it unsafe to go to the working face for a sample of the coal:

Dean Coal Company No. 1 Mine—No. 200 on Map II.

On south side of North Branch of Potomac River, 0.4 mile northwest of Elk Garden; **Bakerstown Coal**; elevation, 1760′ B.

			Ft.	In.
Shale, dark, roof				
Coal, with bony streaks	1′	3″		
Shale, dark-gray	1	0		
Coal, soft, good	2	11	5	2
Fire clay, pavement				

A more western opening, **Dean Coal Company No. 1 Mine (No. 201 on Map II),** of the same operation, located on the same side of North Branch 0.5 mile west of Elk Garden, had fallen shut, its elevation being 1795′ B. Slightly farther west there is a third opening at the top of the plane which descends to the railroad, the elevation of the coal here being 1815′ B.

The following is a commercial mine near Blaine:

Grafton Mining Company ("Freeport") Mine—No. 202 on Map II.

On the south side of North Branch of Potomac River, 0.2 mile southeast of Blaine; **Bakerstown Coal**; elevation, 1875′ B.

			Ft.	In.
1. Shale, dark				
2. **Coal**, bony	0′	9″		
3. **Coal**, medium-hard	0	8		
4. Bone	0	1		
5. **Coal**, medium-hard	0	5		
6. Bone	0	7		
7. **Coal**, soft	2	7	5	1
8. Shale, pavement				

"Principal office, Grafton, W. Va.; daily capacity, 50 tons; 10 miners and 4 laborers employed; pony haulage; coal shipped east for steam fuel; butts, none; faces, none; greatest rise, northeast; I. M. Moon, Assistant Mine Foreman, authority for mine data; sample (No. 494R) collected from Nos. 3, 5, and 7 of section in Room No. 1 off First Left, for composition of which see **Mine No. 202** in the Table of Coal Analyses at the end of this Chapter."

The following section was measured at another entry of the same operation a little farther west around the same hillside:

Grafton Mining Company ("Freeport") Mine—No. 203 on Map II.

On south side of North Branch of Potomac River, 0.2 mile south of Blaine; **Bakerstown Coal**; elevation, 1870′ B.

			Ft.	In.
Sandstone, shaly, **Thomas**			15	0
Shale, dark			4	0
Coal, soft	0′	9″		
Slate	0	1		
Coal	0	5		
Shale, bony	0	4		
Coal, soft	3	3	4	10
Shale, pavement				

At the following mine the coal was formerly operated on a commercial basis but the old plane had been removed. A new plane was contemplated, however, since the property still contained much valuable coal:

St. Cloud Coal Company (Ida) Mine—No. 204 on Map II.

On the south side of North Branch of Potomac River, 0.3 mile southeast of Potomac Manor; **Bakerstown Coal**; elevation, 1965′ B.

			Ft.	In.
1. Shale, dark				
2. **Coal**, soft	1′	3″		
3. Shale, bony	0	10		
4. **Coal**, soft	2	8	4	9
5. Shale, pavement				

A sample (No. 514R) was collected from Nos. 2 and 4 of section in Room No. 4 off Main Heading, the composition of which is published under **Mine No. 204** in the Table of Coal Analyses at the end of this Chapter.

On Abram Creek, which empties into the Potomac River at Harrison, there are several operations in the Bakerstown Coal. The following mine, temporarily idle, was formerly known as the **Davis Coal & Coke Company No. 14:**

Grace Coal Company Mine—No. 205 on Map II.

On south side of Abram Creek, 0.3 mile west of Oakmont; **Bakerstown Coal**; elevation, 2020′ B.

			Ft.	In.
1. Shale, sandy				
2. Slate, dark			0	6
3. **Coal**, soft	1′	0″		
4. Slate, bony	0	2		
5. **Coal**, soft	0	4		
6. **Coal**, bony	0	8		
7. **Coal**, soft	2	8	4	10
8. Shale, pavement				

"Principal office, Oakmont, W. Va.; coal leased from the Davis Coal & Coke Company; daily capacity, 50 tons; 8 miners and 3 laborers employed; pony haulage; greatest rise, northwest; D. W. Love, miner and caretaker, authority for mine data; sample (No. 521R) collected from Nos. 3, 5, and 7 of section in first Dip air-course, for composition of which see **Mine No. 205** in the Table of Coal Analyses at the end of this Chapter."

The following mine, formerly known as the Abrams Creek Coal and Coke Company, is a large and well-equipped operation, but was temporarily closed when visited:

Brady Coal Corporation (Abrams Creek) Mine—No. 206 on Map II.

On the south side of Abram Creek, at Oakmont; **Bakerstown Coal**; elevation, 1965′ B.

			Ft.	In.
1. Shale				
2. **Coal,** soft	0′	8½″		
3. Bone	0	1½		
4. **Coal,** soft	0	9		
5. Bone	0	2		
6. **Coal,** soft	2	9	4	6
7. Shale, pavement				

"Principal office, Fairmont, W. Va.; coal leased from Homan and Kalbaugh; daily capacity, 350 tons; 35 miners and 26 laborers employed; electric haulage; coal shipped east for steam and domestic purposes; greatest rise, northwest; Thomas Strachan, Acting Superintendent, authority for mine data; sample (No. 520R) collected from Nos. 2, 4, and 6 of section in face of First Butt off 9th Left, for composition of which see **Mine No. 206** in the Table of Coal Analyses at the end of this Chapter."

The **Davis Coal and Coke Company No. 15 Mine (No. 207 on Map II)**, located on the north side of Abram Creek, 0.5 mile east of Oakmont, at elevation 1920′ B., is now abandoned and dismantled. The following is a recently installed operation, temporarily idle when examined:

Donley Coal Company Mine—No. 208 on Map II.

On the east side of Abram Creek, 0.7 mile east of Oakmont; **Bakerstown Coal**; elevation, 1915′ B.

			Ft.	In.
1. Shale, black				
2. **Coal,** soft	0′	9″		
3. Slate, bony	0	8		
4. **Coal,** soft, columnar	2	2	3	7
5. Slate, pavement				

"Principal office, Elk Garden, W. Va.; daily capacity, 50 tons; 4 miners and 2 laborers employed; mule haulage; coal shipped east

Photo by E. E. HARRIS.

PLATE XXXII.—Greenland Gap, looking east through valley of North Fork of Patterson Creek. The White Medina Sandstone, which forms a complete arch, is visible in escarpment of New Creek Mountain at left, the dip on western side being shown by fringe of trees down to projecting white cliff in middle. The same formation to right of gap is less plainly visible. A portion of Knobly Mountain is seen in middle distance, with Patterson Creek Mountain in extreme rear.

for steam purposes; greatest rise, northwest; James V. Healy, Superintendent, authority for mine data; sample (No. 510R) collected from Nos. 2 and 4 of sect on in Room No. 1 off air-course, for composition of which see Mine I.o. 208 in the Table of Coal Analyses at the end of this Chapter."

The following opening was not in operation:

Mapleville Coal Company Mine—No. 209 on Map II.

On the east side of Abram Creek, 0.7 mile east of Oakmont; **Bakerstown Coal**; elevation, 1915' B.

		Ft.	In.
Shale, dark			
Coal, soft	0' 11"		
Coal, bony	0 2		
Coal, soft	0 7		
Bone	0 2		
Coal, soft	2 2	4	0
Shale, pavement			

On the west side of the creek the Carroll-Cross Coal Company has several closely connected entries known as the Imperial Mines, the three following sections being made in order from north to south:

Carroll-Cross Coal Company (Imperial) Mine—No. 210 on Map II.

On the west side of Abram Creek, 0.6 mile southeast of Oakmont; **Bakerstown Coal**; elevation, 1930' B.

		Ft.	In.
Shale, sandy and dark		10	0
Coal, bony	0' 5"		
Coal, soft	1 1		
Bone	0 6		
Coal, soft	2 3	4	3
Shale, pavement			

The above entry is the most northern opening.

Carroll-Cross Coal Company (Imperial) Mine—No. 211 on Map II.

On west side of Abram Creek, 0.8 mile southeast of Oakmont; **Bakerstown Coal**; elevation, 1915' B.

		Ft.	In.
Sandstone, shaly			
Coal, soft	0' 7"		
Shale, bony	0 10		
Coal, soft	2 3	3	8
Shale, pavement			

The above entry is just north of the company tipple.

Carroll-Cross Coal Company (Imperial No. 2) Mine—No. 212 on Map II.

On the west side of Abram Creek, 0.5 mile northwest of Emoryville Station; **Bakerstown Coal**; elevation, 1900′ B.

			Ft.	In.
1. Sandstone			15	0
2. Shale, dark			5	0
3. **Coal**, bony	0′	4½″		
4. **Coal**, soft	1	0		
5. Bone, 0′ 0½″ to	0	1½		
6. **Coal**, soft	2	5	3	11
7. Shale, pavement				

"Principal office, Emoryville, W. Va.; coal leased from W. Va. Central and Pittsburgh Railway; daily capacity, 100 tons; 18 miners and 7 laborers employed; mule haulage; greatest rise, northwest; B. H. Cross, Superintendent, authority for mine data; sample (No. 519R) collected from Nos. 4 and 6 of section in room off Main Heading, 600 feet in, for composition of which see **Mine No. 212** in the Table of Coal Analyses at the end of this Chapter."

The above is the most southern entry of the group served by a common tipple.

Above this opening the Bakerstown Coal goes under drainage across the Stony River Syncline and is not mined again on the waters of Abram Creek in Mineral County, but its blossom is exposed in the public road at the **A. C. Dixon Coal Exposure (No. 213 on Map II)**, on the waters of a branch of Emory Run 1.1 miles southeast of Sulphur City, at elevation 2685′ B., this locality being in the region of steep dip along the slope of the Allegheny Front.

On the south side of North Branch of Potomac River 0.2 mile south of Gleason, the coal is partly visible at the **Gleason Coal and Coke Company Prospect (No. 214 on Map II)**, at elevation 2200′ B., there being 3′ 3″ exposed, including partings, as detailed in the Gleason Section, page 171.

At **Coal Exposure No. 215 on Map II**, along a mountain road 0.5 mile east of North Branch of Potomac River and 0.5 mile east of Schell, at elevation 2395′ B., only the blossom of the coal is visible.

The three following farm mines are located on the Maryland side of the Potomac in Garrett County:

Farm Mine—No. 216 on Map II.

Garrett County, Maryland; on a branch of Lostland Run of North Branch of Potomac River, 1.6 miles northeast of Tasker Corners; **Bakerstown Coal**; elevation, 2455′ B.

			Ft.	In.
Shale, dark				
Coal, soft	0′	7″		
Slate, bony	0	2		
Coal, soft	1	3		
Slate, dark	0	2		
Coal, soft	1	2		
Slate, dark	0	1		
Coal, soft	0	9	4	2
Shale, pavement (dip southeast)				

Asa Moon Farm Mine—No. 217 on Map II.

Garrett County, Maryland; on the west side of Trout Run of Laurel Run of North Branch of Potomac River, 2 miles northwest of Schell; **Bakerstown Coal**; elevation, 2475′ B.

			Ft.	In.
Sandstone, shaly				
Shale, sandy			10	0
Coal, soft	0′	5½″		
Coal, bony	0	5		
Coal, soft	0	8		
Coal, bony	0	4		
Coal, soft	0	5½		
Slate, bony	0	5		
Coal, soft	2	4	5	1
Shale, pavement				

N. B. Harvey Farm Mine—No. 218 on Map II.

Garrett County, Maryland; on the head of Glade Run, 1 mile northwest of Kearney; **Bakerstown Coal**; elevation, 2675′ B.

			Ft.	In.
1. Sandstone, shaly			10	0
2. Shale, sandy			5	0
3. **Coal**, soft	0′	6″		
4. Slate, bony	0	2		
5. **Coal**, soft	0	9		
6. **Coal**, bony	0	3		
7. **Coal**, soft	0	6		
8. Slate, bony	0	3		
9. **Coal**, soft	1	3	3	8
10. Shale, pavement				

A sample (No. 470R) was collected from Nos. 3, 5, 7, and 9 of section, the composition of which is published under **Mine No. 218** in the Table of Coal Analyses at the end of this Chapter.

Bakerstown ("Thomas") Coal, Union District, Grant County.

In Union District the Bakerstown Coal has been prospected extensively and has been mined both for local fuel and commercial shipment, and many borings have been made to test its thickness in localities where there are no outcrops, so that its character and development are quite well defined. The evidence shows that there are a few locally barren or thin areas but that in most of the region where its horizon occurs good coal is found.

The three following openings are farm mines on the waters of Abram Creek, all of them being on the southeast side of the axis of the Stony River Syncline and all having a southeastward rise toward the Allegheny Front:

W. W. Kitzmiller Farm Mine—No. 219 on Map IV.

On Glade Run of Abram Creek, 1.7 miles southwest of Hartmansville; **Bakerstown Coal**; elevation, 2355′ B.

		Ft.	In.
1. Shale, sandy		10	0
2. **Coal**, bony, **Upper Bakerstown (Exposure No. 178)**		1	0
3. Shale, dark, sandy		10	0
4. Bone	0′ 6″		
5. **Coal**, soft	0 4		
6. **Coal**, very bony	0 11		
7. **Coal**, soft	2 3	4	0
8. Shale, pavement			

A sample (No. 476R) was collected from Nos. 5 and 7 of section, the composition of which is published under **Mine No. 219** in the Table of Coal Analyses at the end of this Chapter.

W. W. Kitzmiller Farm Mine—No. 220 on Map IV.

On the west side of Abram Creek, 2.3 miles southwest of Hartmansville; **Bakerstown Coal**; elevation, 2410′ B.

		Ft.	In.
Shale, dark			
Bone	0′ 7″		
Coal, soft	0 3		
Coal, very bony	0 11		
Coal, soft	3 0	4	9
Shale, pavement			

W. H. Kitzmiller Farm Mine—No. 221 on Map IV.

On the west side of Abram Creek, 2.5 miles northeast of Mount Storm; **Bakerstown Coal**; elevation, 2560′ B.

			Ft.	In.
1. Shale, sandy			10	0
2. **Coal**, very bony	1′ 10″			
3. **Coal**, soft	2 3		4	1
4. Shale, pavement (rapid northwest dip)				

A sample (No. 479R) was collected from No. 3 of section, about 50 feet in the entry, its composition being published under **Mine No. 221** in the Table of Coal Analyses at the end of this Chapter.

The **Mrs. Wm. S. Fisher Farm Mine (No. 222 on Map IV)**, located on the east side of Abram Creek 2.3 miles southeast of Mount Storm, at elevation 2765′ B., had fallen shut, its thickness being reported by Tully Duling, a resident, as 4′ 0″.

The **J. L. Moore Farm Mine (No. 223 on Map IV)**, located in the angle at the junction of Little and Abram Creeks 0.8 mile northeast of Bismarck, at elevation 2800′ B., had also fallen shut, its thickness being reported as 2′ 8″ of clean coal.

The following is the most southern Bakerstown opening noted on the waters of Abram Creek:

M. F. Cosner Farm Mine—No. 224 on Map IV.

On the east side of Abram Creek, 0.5 mile northeast of Bismarck; **Bakerstown Coal**; elevation, 2865′ B.

			Ft.	In.
1. Shale, sandy			10	0
2. **Coal**, bony	1′ 0″			
3. **Coal**, soft	2 1		3	1
4. Shale, pavement				

A sample (No. 481R) was collected from No. 3 of section, at the mine face 50 feet under cover, the composition of which is published under **Mine No. 224** in the Table of Coal Analyses at the end of this Chapter.

The two following openings are adjacent entries at the Kuhn Farm Mine at the bend of Stony River northwest of Mount Storm. At this point the seam bears an enviable reputation and despite the fact that a long haul is required to get it to the top of the plateau a large amount of coal has been hauled by wagon from this mine:

Elmer Kuhn Farm Mine—No. 225 on Map IV.

On the east side of Stony River, at the mouth of Eye Run, 1 mile northwest of Mount Storm; **Bakerstown Coal**; elevation, 2475′ B.

			Ft.	In.
1. Shale, sandy				
2. **Coal**, very bony	1′	2″		
3. Bone and slate, mixed	0	5		
4. **Coal**, soft, columnar	2	5	4	0
5. Shale, pavement				

A sample (No. 478R) was collected from No. 4 of section, the composition of which is published under **Mine No. 225** in the Table of Coal Analyses at the end of this Chapter.

Elmer Kuhn Farm Mine—No. 226 on Map IV.

On the east side of Stony River, at the mouth of Eye Run, 1 mile northwest of Mount Storm; **Bakerstown Coal**; elevation, 2470′ B.

			Ft.	In.
Shale, dark				
Coal, medium-hard	0′	4″		
Coal, bony	0	11		
Bone	0	6		
Coal, soft	2	11	4	8
Shale, pavement				

At the **J. W. Cosner Exposure (No. 227 on Map IV)**, located on a branch of Stony River 1 mile southwest of Accident School and 2.2 miles northwest of Bismarck, at elevation 3160′ B., where the coal is partly visible in a spring, the owner reports a thickness of 1′ 6″. This outcrop is doubtfully classified as the Bakerstown but may be the Upper Bakerstown or possibly the Harlem, the elevation being apparently somewhat too high for Bakerstown.

The five following openings and prospects are on the upper waters of Stony River:

Herr and Company Farm Mine—No. 228 on Map IV.

On the west side of Stony River, 1.8 miles southwest of Bismarck; **Bakerstown Coal**; elevation, 3130′ B.

			Ft.	In.
1. Sandstone, shaly			10	0
2. Shale, dark			5	0
3. Bone, cannel			0	11
4. **Coal**, bony	0′	4″		
5. **Coal**, soft	0	5		
6. Slate, bony	0	3		
7. **Coal**, soft	1	7	2	7
8. Shale, pavement (slight dip east)				

A sample (No. 487R) was collected from Nos. 5 and 7 of section, the composition of which is published under **Mine No. 228** in the Table of Coal Analyses at the end of this Chapter.

Herr and Company Prospect—No. 229 on Map IV.

On the east side of Stony River, 2.3 miles southwest of Bismarck; **Bakerstown Coal**; elevation, 3130′ B.

			Ft.	In.
Sandstone, massive				
Coal, soft, rotten	0′	6″		
Shale, dark, bony	0	7		
Coal, soft	1	8	2	9
Shale and concealed, to Stony River			15	0

Herr and Company Prospect—No. 230 on Map IV.

On the west side of Helmick Run of Stony River, 0.3 mile above its mouth; **Bakerstown Coal**; elevation, 3265′ B.

			Ft.	In.
1. Shale, sandy			8	0
2. Slate, black, cannel			2	0
3. **Coal**, soft, 0′ 4″ to	0′	7″		
4. Slate, dark, bony	0	2		
5. **Coal**, soft, 1′ 8″ to	1	10	2	7
6. Shale, pavement (level strata)				

A sample (No. 486R) was collected from Nos. 3 and 5 of section, the composition of which is published under **Mine No. 230** in the Table of Coal Analyses at the end of this Chapter.

Parsons Pulp and Lumber Company Exposure—No. 231 on Map IV.

On the west side of Mud Run, 0.3 mile southeast of Stony River Dam; **Bakerstown Coal**; elevation, 3470′ B.

			Ft.	In.
Shale, dark				
Coal, bony	0′	6″		
Coal, soft	1	0	1	6
Shale, pavement				

Parsons Pulp and Lumber Company Prospect—No. 232 on Map IV.

On the west side of Mud Run, 0.5 mile southeast of Stony River Dam; **Bakerstown Coal**; elevation, 3470′ B.

			Ft.	In.
Shale, dark			10	0
Coal, bony	0′	6″		
Shale, dark	1	0		
Coal, soft	1	0	2	6
Shale, pavement				

The following mine has been recently opened for commercial shipment on the Maryland side of the Potomac, by the Potomac River Coal Company, of Passaic, New Jersey:

Potomac River Coal Company (Hilltop) Mine—No. 233 on Map IV.

Garrett County, Maryland; on the north side of North Branch of Potomac River, 0.4 mile northwest of Steyer; **Bakerstown Coal**; elevation, 2560′ B.

			Ft.	In.
Shale, sandy and dark			20	0
Coal, soft	0′	5″		
Coal, bony	0	3		
Coal, soft	1	5		
Coal, bony	0	2		
Coal, soft	2	1	4	4
Shale, pavement				

The **Strathmore Coal Company Mine (No. 234 on Map IV)**, located in Garrett County, Maryland, on the west side of Glade Run of North Branch 1.3 miles northeast of Gorman, at elevation 2455′ B., where the coal was formerly mined for commercial shipment, has now been abandoned and has fallen shut. The following prospect is along the same stream:

Wm. Wilson Prospect—No. 235 on Map IV.

Garrett County, Maryland; on the west side of Glade Run, 1.3 miles northeast of Gorman; **Bakerstown Coal**; elevation, 2400′ B.

			Ft.	In.
1. Shale, dark, sandy				
2. **Coal**, soft	0′	5″		
3. **Coal**, bony	0	2		
4. **Coal**, soft	0	10		
5. **Coal**, bony	0	2		
6. **Coal**, soft	0	5		
7. Bone	0	3		
8. **Coal**, soft	1	9	4	0
9. Shale, pavement (dip northwest)				

A sample (No. 469R) was collected from Nos. 2, 4, 6, and 8 of section, the composition of which is published under **Mine No. 235** in the Table of Coal Analyses at the end of this Chapter.

The five following farm mines and prospects are on the West Virginia side of the river:

J. W. Brock Farm Mine—No. 236 on Map IV.

On the south side of North Branch of Potomac River, 0.5 mile southwest of Steyer; **Bakerstown Coal**; elevation, 2610′ B.

			Ft.	In.
Sandstone, shaly			15	0
Shale, sandy			3	0
Sandstone			1	0
Coal	0′	5″		
Bone	0	2		
Coal	0	5		
Coal, bony	0	5		
Coal	0	5½		
Slate, dark	0	3½		
Coal	1	5	3	7
Shale, pavement				

E. C. Harvey Farm Mine—No. 237 on Map IV.

On the south side of North Branch of Potomac River, 1.2 miles east of Gormania; **Bakerstown Coal**; elevation, 2590′ B.

			Ft.	In.
Shale, dark				
Bone	0′	2½″		
Coal	0	2½		
Bone	0	3		
Coal	0	10		
Coal, bony	0	4		
Coal	0	7		
Bone	0	3		
Coal	0	11	3	7
Shale, pavement				

S. H. Jordan Prospect—No. 238 on Map IV.

On the south side of North Branch of Potomac River, 1.1 miles northeast of Gormania; **Bakerstown Coal**; elevation, 2535′ B.

			Ft.	In.
Shale, dark				
Coal	1′	3½″		
Coal, bony	0	3½		
Coal	0	8		
Bone	0	6		
Coal	0	7		
Bone	0	4		
Shale, hard	1	3		
Coal	0	2	5	1
Shale, pavement				

The **S. H. Jordan Prospect (No. 239 on Map IV)**, located on the south side of North Branch of Potomac River 1 mile northeast of Gormania, at elevation 2530′ B., had fallen shut, the coal being reported by the owner as only 0′ 10″ thick. The

S. H. Jordan Prospect (No. 240 on Map IV), located on the south side of North Branch of Potomac 0.8 mile northeast of Gormania, at elevation 2515′ B., had also fallen shut, being reported by Mr. Jordan as 0′ 10″ thick.

The following is a commercial operation on the Maryland side of the Potomac:

W. A. Price Mine—No. 241 on Map IV.

Garrett County, Maryland; on the east side of Nydegger Run, 0.3 mile north of Gorman; **Bakerstown Coal**; elevation, 2340′ B.

			Ft.	In.
Sandstone, shaly, **Thomas**			10	0
Shale, sandy			5	0
Coal	0′	4″		
Bone	0	2		
Coal	0	10		
Bone	0	2		
Coal	0	7		
Bone	0	2		
Coal, soft	1	4		
Shale, gray	1	2		
Coal	0	4	5	1
Shale, pavement				

The **W. D. Althouse and Company Prospect (No. 242 on Map IV)**, located in Garrett County, Maryland, on the north side of North Branch of Potomac River 0.6 mile southwest of Gormania, at elevation 2387′ B., had partly fallen shut, no section being measured. The following is a commercial operation by the same interests:

W. D. Althouse and Company (Georgeian) Mine—No. 243 on Map IV.

Garrett County, Maryland; on the north side of North Branch of Potomac River, 0.8 mile southwest of Gormania; **Bakerstown Coal**; elevation, 2405′ B.

			Ft.	In.
Shale, dark				
Coal, bony	0′	3″		
Coal, soft	0	8½		
Bone	0	2		
Coal	0	7½		
Bone and slate	0	3½		
Coal	1	6½	3	7
Shale, pavement				

The following is a small commercial mine on the Maryland side near Bayard:

McKanwig Coal Company (Nethken) Mine—No. 244 on Map IV.

Garrett County, Maryland; on the north side of North Branch of Potomac River, opposite Bayard; **Bakerstown Coal**; elevation, 2385′ B.

			Ft.	In.
Shale, sandy			20	0
Coal	0′	6″		
Coal, bony, and bone, mixed	1	3		
Coal, soft	2	9	4	6
Shale, gray, visible			4	0

The following mine, which is a small commercial plant at Bayard, was not in operation when visited, there being too much water in the haulageway to permit an entrance for sampling. The section was measured under unfavorable conditions near the mouth of the mine and probably differs somewhat from that which would be found at the face:

W. A. Price Mine—No. 245 on Map IV.

On the south side of North Branch of Potomac River at Bayard; **Bakerstown Coal**; elevation, 2375′ B.

			Ft.	In.
Shale, sandy				
Coal, medium-hard	1′	6″		
Shale, gray	0	2		
Coal, medium-soft	1	10	3	6
Slate, pavement				

"Principal office, Gorman, Maryland; coal owned by Reece and Arnold; daily capacity, 25 tons; 10 or 12 men employed; mule haulage; a resident of Bayard, authority for mine data."

Just above Bayard the Bakerstown Coal goes under drainage and so remains to the head of the Potomac but it has been mined on an extensive scale by shaft at Henry where it is 216 feet down to the coal. The following section was obtained at this plant:

Davis Coal & Coke Company No. 22 Mine—No. 246 on Map IV.

On the south side of North Branch of Potomac River, 0.3 mile southwest of Henry; **Bakerstown Coal**; elevation, 2660′ B.

		Ft.	In.
1. Sandstone			
2. **Coal**	0′ 7″		
3. Bone	0 3		
4. **Coal**	0 2		
5. Bone	0 4		
6. **Coal**, soft	3 6	4	10
7. Shale, pavement			

"Principal office, Continental Trust Building, Baltimore, Maryland; daily capacity, 600 tons; 80 miners and 50 laborers employed; electric haulage; coal shipped east for steam fuel; butts, none; faces, none; greatest rise, southeast; J. R. Hubbs, Superintendent, authority for mine data; sample (No. 489R) collected from No. 6 of section in First Left Parallel, Grimes No. 8 Room, for composition of which see **Mine No. 246** in the Table of Coal Analyses at the end of this Chapter."

At the request of the writer Mr. Chas. A. Burdick, a well-known mining engineer of New York City, and inventor of a process for removing free ash and pyritic sulphur from coal by passing the pulverized material through a vat of water containing a small percentage of oil in a manner that is closely analogous to the flotation process in metallurgy, has kindly made a test of the Bakerstown Coal from the Henry Mine from samples furnished by Mr. S. B. Jeffries, Chief Engineer of the Davis Company. The report of Mr. Burdick is as follows, attention being called to the fact that the Bakerstown Coal was for many years known as the "Upper Freeport" in this region and the former nomenclature was evidently applied to the samples by Mr. Jeffries:

"March 28th, 1922.

"Mr. S. B. Jeffries, Chief Engr.,
Davis Coal & Coke Company,
Thomas, West Virginia.

"Dear Sir:

"The samples of coal obtained from the Upper Freeport seam and taken by Supt. J. R. Hubbs from Henry Mine No. 22, have been tested. The products have been analyzed by the Continental Smelting & Refining Company of Newark, New Jersey, and their certificate of analysis is enclosed.

"In the following tables, the analysis of the head samples has been calculated and should be correct as there was no loss in treatment unless there is a water soluble content.

"When the concentrates were swirled in a flask, practically no pyrite collected at the bottom, indicating that the sulphur remaining in the concentrates is not in the form of pyrite.

TEST 40B—Sample No. 1—HENRY MINE NO. 22.

Products.	Dry Wt.	% Wt.	% Ash.	Wt. Ash Per 100 Feed.	% Total Ash.	% Sulphur.	Wt. Sul. per 100 Feed.	% Total Sulphur.
Concentrates	41.12	77.5	6.0	4.55	46.7	1.80	1.40	44.4
Tailings	11.90	22.5	23.1	5.20	53.3	7.60	1.71	55.6
Heads (Calculated)	53.02	100.0	9.75	9.75	100.0	3.11	3.11	100.0

TEST 41A—Sample No. 2—HENRY MINE NO. 22.

Concentrates	43.65	81.0	5.5	4.46	54.7	1.80	1.46	53.1
Tailings	10.25	19.0	19.4	3.69	45.3	6.80	1.29	46.9
Heads (Calculated)	53.90	100.0	8.15	8.15	100.0	2.75	2.75	100.0

"From the table, you will note that from Sample 1, 77.5% of the coal can be recovered in a product containing 6.0% ash and 1.8% sulphur. Sample No. 2 indicates that 81% of the coal can be recovered in a product containing 5.5% ash and 1.8% sulphur.

"In a standard unit a slight improvement in quality may be expected. I desire to learn your opinion of the results, as this coal can be treated at a low cost per ton.

"Awaiting your opinion of the results, I am

"Yours very truly,

(Signed) C. A. Burdick."

From the above tests it will be noted that the "Heads," or original, Sample No. 1, used in Test 40B, contained 9.75 per cent. ash, which was reduced to only 6.00 per cent. in the concentrates, and there was a reduction from 3.11 to 1.80 in sulphur. In sample No. 2 a similar reduction in both these impurities is clearly indicated. If such results could be maintained in practice, which appears probable, the installation of at least one experimental plant using this, or some similar process, somewhere in the Potomac region would seem justified, since the moderately high ash of most of the coals of the valley is reduced to an unobjectionable minimum and the concurrent reduction in sulphur is of equal value. Obvious disadvantages are the necessity of pulverizing the coal and of using it in that form afterward or else of making it into briquettes, and the evident loss of tonnage through waste. It would appear plausible, however, that a full-sized unit working under favorable conditions might reduce this latter factor to probably not more than 10 per cent. as compared to the loss of 20 per cent. or more indicated in the laboratory sample.

Quantity of Bakerstown ("Thomas") Coal Available.

The following table, compiled by Tucker from a planimetric measurement of the outcrops on Maps II and IV, shows the probable amount of Bakerstown ("Thomas") Coal in the two counties:

Probable Amount of Bakerstown ("Thomas") Coal.

Districts.	Thickness of Coal Assumed. Feet.	Square Miles.	Acres.	Cubic Feet of Coal.	Short Tons of Coal.
Mineral County:					
Piedmont	2½	5.65	3,616.0	393,782,400	15,751,296
Elk	3	39.15	25,056.0	3,274,318,080	130,972,723
Totals		44.80	28,672.0	3,668,100,480	146,724,019
Grant County:					
Union	3	80.70	51,648.0	6,749,360,640	269,974,426
Gr. Totals for Area		125.50	80,320.0	10,417,461,120	416,698,445

The amount of Bakerstown Coal already mined is wholly negligible as compared to the total, so that no reduction need be made from the above figures in allowance for such an item.

MAHONING ("SIX-FOOT") COAL.

The Mahoning ("Six-foot") Coal, previously discussed in Chapter VII, page 230, where its position above the true Upper Freeport and therefore at or near the horizon of the Mahoning Coal has been emphasized, is a minable coal of much value in Piedmont District, Mineral County. Southwestward from Piedmont District it becomes lenticular, there being occasional areas of good coal, but in the southern end of Elk District, Mineral County, and in all of Union District, Grant County, the coal at this horizon is so thin that there is no probability that it can ever be exploited, there being many localities where it is entirely absent. In the areas mentioned as containing a minable thickness it has been operated extensively for commercial shipment, being soft, uniformly low in sulphur, and well adapted for steam fuel. Figure 23 shows the portion of Mineral County within which is included all the minable area of Mahoning Coal, but at the same time does not show the barren localities within this area.

These latter must be noted from local measured sections published in Chapter V and in the following descriptions of prospects. On Map II the outcrop of the coal is delineated for the same area as embraced by Figure 23.

Mahoning ("Six-foot") Coal, Piedmont District, Mineral County.

In Piedmont District the Mahoning Coal has its best development of the whole valley, being characterized as the "Piedmont" Coal by the Maryland Survey in its recent Volume XI. It has been mined extensively, both on the West Virginia and Maryland sides of the river, and apparently has minable thickness at all points where its horizon occurs within Piedmont District.

The following is a new operation from which coal has not yet been shipped, its location being high up against the slope of the Allegheny Front where the coals are rising rapidly southeastward:

Hoffa-Martin Coal Company Mine—No. 252 on Map II.

On the west side of Slaughterhouse Run, 1 mile southeast of Piedmont; **Mahoning Coal**; elevation, 1480′ B.

		Ft.	In.
1. Sandstone, massive			
2. Slate, dark, 0′ 3″ to		1	6
3. **Coal**, good	1′ 0½″		
4. Slate, dark	0 0½		
5. **Coal**, good	2 10	3	11
6. Slate, pavement			

A sample (No. 463R) was collected from Nos. 3, 4, and 5 of section, at face of air-course, 50 feet under cover, the composition of which is published under **Mine No. 252** in the Table of Coal Analyses at the end of this Chapter.

The following section was measured at the most southeastern outlet of the Twin Mountain Coal Company, next to Slaughterhouse Run:

Twin Mountain Coal Company Mine—No. 253 on Map II.

On the south side of North Branch of Potomac River, 0.8 mile southeast of Piedmont; **Mahoning Coal**; elevation, 1365′ B.

		Ft.	In.
Sandstone, massive			
Shale, dark		3	0
Coal, bony	0′ 7″		
Coal, soft	1 10	2	5
Shale, pavement			

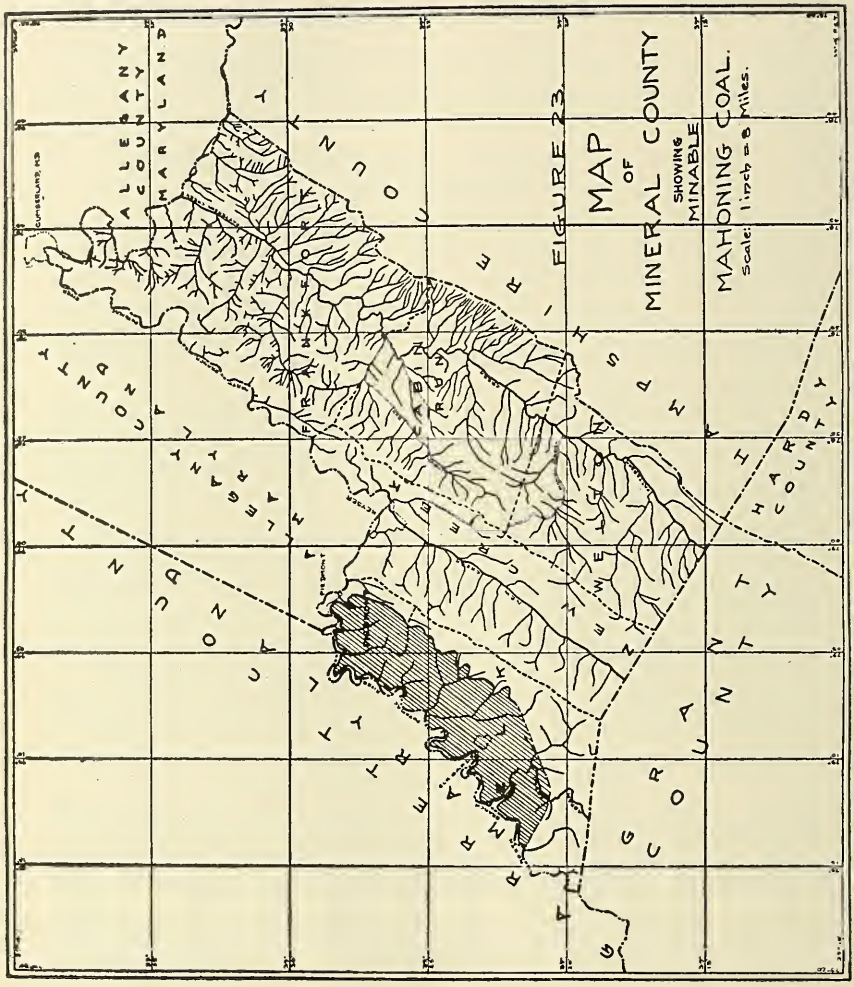


FIGURE 23.
MAP
OF
MINERAL COUNTY
SHOWING
MINABLE
MAHONING COAL.
Scale: 1 inch = 8 Miles.
ALLEGANY COUNTY MARYLAND
GARRETT COUNTY
PRESTON COUNTY
TUCKER COUNTY
RANDOLPH COUNTY
GRANT COUNTY
HARDY COUNTY
HAMPSHIRE COUNTY
MORGAN COUNTY
BERKELEY COUNTY
JEFFERSON COUNTY
FREDERICK COUNTY
WASHINGTON COUNTY
BERKELEY SPRINGS
CUMBERLAND
PATTERSON CREEK
POTOMAC RIVER
NORTH BRANCH
SOUTH BRANCH
CACAPON MOUNTAIN
NORTH MOUNTAIN
GREAT NORTH MOUNTAIN
ALLEGHANY MOUNTAIN
BACKBONE MOUNTAIN
DOLLY SODS
BLACKWATER
CANAAN MOUNTAIN
SHENANDOAH MOUNTAIN
BLUE RIDGE
SIDLING HILL MOUNTAIN
TIMBER RIDGE
MEADOW MOUNTAIN
SHAVER MOUNTAIN
ROCKY MOUNTAIN
BIG MOUNTAIN
BIG SCHLOSS
BIG SCHLOSS
BIG SCHLOSS

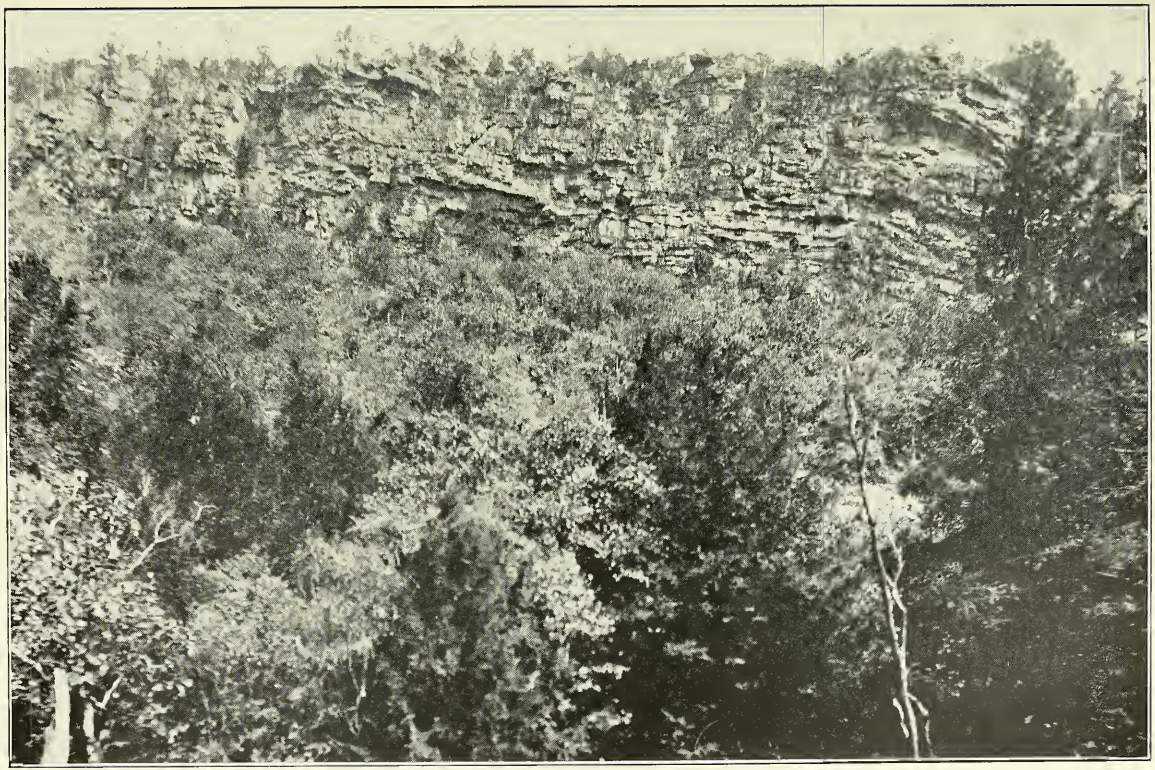


Photo by E. E. HARRIS.

PLATE XXXIII.—View of White Medina Sandstone cliff (317 feet thick) in New Creek Mountain on north side of Greenland Gap, taken from opposite slope. Fracture of stone is typical.

The **Twin Mountain Coal Company Mine (No. 254 on Map II)**, located on the south side of North Branch of Potomac River 0.7 mile southeast of Piedmont, at elevation 1360′ B., is an abandoned entry next in succession west of No. 253. Just beneath this entry is an old prospect in the Upper Freeport Coal, coming 20 feet by hand-level measurement below the Mahoning. The elevation at the following section was obtained at the present main entry of the Twin Mountain Company which comes next westward after No. 254 and the section was measured within the honey-combed mountain as recorded in the notes. Although not in active operation this mine was self draining and well ventilated:

Twin Mountain Coal Company (Fahey) Mine—No. 255 on Map II.

On the south side of North Branch of Potomac River, 0.6 mile southeast of Piedmont; **Mahoning Coal**; elevation, 1330′ B.

			Ft.	In.
1. Sandstone, massive				
2. Draw slate				
3. **Coal**	0′	9″		
4. **Coal**, bony	0	7		
5. **Coal**, breast	1	9		
6. Bone	0	1		
7. **Coal**, bottom	2	5	5	7
8. Shale, pavement				

"Principal office, Piedmont, W. Va.; daily capacity, 150 tons; 22 miners and 9 laborers employed; mule haulage; coal shipped east for steam fuel; butts, none; faces, none; greatest rise, southeast; J. M. Fahey, Superintendent, authority for mine data; sample (No. 474R) collected from Nos. 3, 5, and 7 of section in Room No. 1 of old mine, for composition of which see **Mine No. 255** in the Table of Coal Analyses at the end of this Chapter."

The **Potomac Fire Brick Company Coal Mine (No. 256 on Map II)**, located on the south side of North Branch of Potomac River 0.5 mile southeast of Piedmont, at elevation 1270′ B., is now abandoned and has fallen shut; and the **Potomac Fire Brick Company Coal Mine (No. 257 on Map II)**, on the same hillside 0.4 mile southeast of Piedmont, at elevation 1235′ B., is also abandoned and fallen shut.

Farm Mine No. 258 on Map II, on the south side of North Branch of Potomac River 0.3 mile south of Piedmont, at elevation 1255′ B., is abandoned and fallen shut. The following is a farm mine that is still in operation:

John Mullen Farm Mine—No. 259 on Map II.

On the south side of North Branch of Potomac River, 0.5 mile south of Piedmont; **Mahoning Coal**; elevation, 1250′ B.

			Ft.	In.
Sandstone, massive				
Shale, dark			5	0
Coal	0′	2″		
Slate, bony	0	2		
Coal, soft	1	5		
Coal, bony	0	3		
Coal, soft	2	4	4	4
Shale, pavement				

Coal Prospect No. 260 on Map II, on the south side of North Branch of Potomac River 0.2 mile south of Luke, at elevation 1288′ B., is abandoned and has fallen shut.

The following commercial operation, formerly known as the **Davis Coal and Coke Company No. 19 Mine,** was temporarily closed on account of the regional shut-down but an entrance was afforded by the present owners for examining and sampling the coal:

Silver Coal Company No. 1 Mine—No. 261 on Map II.

On the east side of Montgomery Run, 0.4 mile south of W. Va. Central Junction; **Mahoning Coal**; elevation, 1170′ B.

			Ft.	In.
1. Shale, dark				
2. **Coal**, soft	0′	7½″		
3. **Coal**, bony	0	7		
4. **Coal**, soft	1	9½		
5. Slate, dark	0	1		
6. **Coal**, soft	2	9	5	10
7. Shale, pavement				

"Principal office, Luke, Maryland; coal leased from the Davis Coal & Coke Company; daily capacity, 50 tons; 8 miners and 2 laborers employed; mule haulage; coal shipped east for steam and domestic purposes; greatest rise, southeast; Lewis Grant, Superintendent, authority for mine data; sample (No. 530R) collected from Nos. 2, 4, and 6 of section in Room No. 3 off Main Heading, for composition of which see **Mine No. 261** in the Table of Coal Analyses at the end of this Chapter."

The following section was measured in an abandoned entry of the same company located just southeast of the power house and 0.1 mile south of No. 261:

Silver Coal Company Mine (Abandoned)—No. 262 on Map II.

On the east side of Montgomery Run, 0.6 mile south of W. Va. Central Junction; **Mahoning Coal**; elevation, 1175′ B.

			Ft.	In.
Shale, dark				
Coal	0′	8″		
Coal, bony	0	5		
Coal, soft	1	7		
Slate, black	0	1		
Coal, soft	1	5	4	2
Shale, pavement				

The **Masteller Coal Company Mine (No. 263 on Map II)**, located on the south side of North Branch of Potomac River at Hampshire, at elevation 1105′ B., had been abandoned and was full of water so that no section could be secured. A prospect recently made by the same company farther south shows the following section:

Masteller Coal Company Prospect—No. 264 on Map II.

On the east side of Piney Swamp Run, 0.5 mile southwest of Hampshire; **Mahoning Coal**; elevation, 1145′ B.

			Ft.	In.
Sandstone, massive				
Shale, dark			4	0
Coal, slaty	0′	.4″		
Slate, dark	0	1		
Coal, soft	1	4	1	9
Shale, pavement				

On the Maryland side of the Potomac numerous entries in the Mahoning Coal have been operated in the vicinity of Westernport and Luke. At **Coal Mine No. 265 on Map II**, located in Allegany County on the north side of North Branch of Potomac River 0.5 mile northeast of Piedmont, at elevation 1295′ B., the entry had been abandoned and had fallen shut. At this point the coal is 45 feet, by hand-level measurement, above the base of the Upper Freeport ("Split-six") Coal. **Coal Mine No. 266 on Map II**, in Allegany County, on the north side of North Branch of Potomac 0.5 mile northeast of Piedmont and about one-eighth mile west of No. 265, had fallen shut, its elevation being 1275′ B. **Coal Mine No. 267 on Map II**, on the same hillside 0.4 mile northeast of Piedmont and 0.1 mile west of No. 267, had also fallen shut, its elevation being 1233′ B.

In Allegany County, Maryland, along the slope of Franklin Hill between Westernport and Luke there have been several openings in the Mahoning ("Six-foot") Coal. **Farm Mine**

No. 268 on Map II, located on this hill 0.4 mile west of the mouth of Georges Creek, at elevation 1110′ B., had fallen shut but there was visible at the outcrop 4′ 6″ of weathered coal. At the **West Virginia Pulp and Paper Company Farm Mine (No. 269 on Map II),** located 0.5 mile north of Luke, at elevation 1133′ B., there is a total of 4′ 9″, with only a small bony parting, as detailed in the Luke Section, page 159. The following mine was in active operation, its product being mainly used by the owners at their paper-mills in Luke and elsewhere:

W. Va. Pulp & Paper Company (Devon No. 1) Mine—No. 270 on Map II.

Allegany County, Maryland; on Franklin Hill, at northwest edge of Luke; **Mahoning Coal;** elevation, 1135′ B. Section in Second Left.

			Ft.	In.
Draw slate				
Coal	1′	0″		
Coal, bony	0	6		
Coal, soft	1	5		
Bone	0	1		
Coal, soft	2	7	5	7
Shale, pavement				

The old **Buxton Mine (No. 271 on Map II),** in Allegany County, Maryland, on Franklin Hill north of North Branch of Potomac River and 0.3 mile northwest of Luke, at elevation 1090′ B., had fallen shut, its thickness not being learned. The following is a commercial operation situated just west of the North Potomac (Georges Creek) Syncline:

R. J. Ross Mine—No. 272 on Map II.

Garrett County, Maryland; on the north side of Savage River, 0.2 mile northeast of Bloomington; **Mahoning Coal;** elevation, 1135′ B.

			Ft.	In.
Shale, sandy			3	0
Shale, dark			2	0
Coal, good	0′	10″		
Coal, bony	0	5		
Coal, good	1	6		
Slate, dark	0	1		
Coal, good	1	11	4	9
Shale, concealed, and shale to Upper Freeport ("Split-six") Coal			49	0

In the angle between Savage River and North Branch of Potomac numerous entries have been made in the coal, several of which are still in operation. The following section was measured at the mouth of one of these, 400 feet southeast of the Bloomington Coal Company tipple:

Bloomington Coal Company Mine—No. 273 on Map II.

Garrett County, Maryland; on the south side of Savage River, 0.3 mile northwest of Bloomington; **Mahoning Coal**; elevation, 1100′ B.

			Ft.	In.
Sandstone, shaly, **Upper Mahoning**			10	0
Shale, dark			1	0
Coal	0′	9″		
Coal, bony	0	7		
Coal, soft	1	10		
Slate, bony	0	2		
Coal, soft	2	2	5	6
Shale, pavement				

The following section was measured in the entry of a mine slightly farther west along Savage River:

G. C. Patterson Mine—No. 274 on Map II.

Garrett County, Maryland; on the south side of Savage River, 0.8 mile northwest of Bloomington; **Mahoning Coal**; elevation, 1130′ B.

			Ft.	In.
Sandstone, shaly				
Draw slate			0	6
Coal	1′	0″		
Slate, dark, hard	1	3		
Coal, visible	3	0	5	3

The **Bloomington Coal Company Mine (No. 275 on Map II)**, located in Garrett County on the north side of North Branch of Potomac River 0.2 mile northeast of Hampshire, at elevation 1095′ B., was temporarily shut down and the entry locked, so that a section could not be secured, but the coal is probably quite similar at the following abandoned entry:

Bloomington Coal Company Mine (Abandoned)—No. 276 on Map II.

Garrett County, Maryland; on the north side of North Branch of Potomac River, 0.2 mile north of Hampshire; **Mahoning Coal**; elevation, 1110′ B.

			Ft.	In.
Shale, dark				
Coal, soft	0′	10″		
Coal, bony	0	6		
Coal, soft	2	0		
Bone	0	2		
Coal, soft	2	3	5	9
Shale, pavement				

The **Bloomington Coal Company Mine (No. 277 on Map II)** in the same hillside 0.2 mile northwest of Hampshire, at elevation 1125′ B., was abandoned and had fallen shut, but the coal is visible at the next entry westward, as follows:

Bloomington Coal Company Mine (Abandoned)—No. 278 on Map II.

Garrett County, Maryland; on the north side of North Branch of Potomac River, 0.4 mile west of Hampshire; **Mahoning Coal**; elevation, 1135′ B.

			Ft.	In.
Shale, sandy, dark			10	0
Coal, bony	1′	1″		
Coal, soft	2	1		
Bone	0	2		
Coal, soft	2	2	5	6
Shale, pavement				

The **Bloomington Coal Company Mine (No. 279 on Map II)**, located on the same hillside 0.4 mile northwest of Hampshire, at elevation 1155′ B., was abandoned and had fallen shut; and the **Bloomington Coal Company Mine (No. 280 on Map II)**, slightly farther west on the same hill and 0.7 mile west of Hampshire, at elevation 1165′ B., was also abandoned, this being the most western of the six old entries described as lying north and northwest of Hampshire. All of these openings are now abandoned except No. 275 from which a haulage track passes around the end of the mountain to the company tipple near Bloomington.

Mahoning ("Six-foot") Coal, Elk District, Mineral County.

The openings above described in Piedmont District and in the adjoining territory of Maryland offer abundant proof of the general continuity and value of the Mahoning Coal in the vicinity of Piedmont, its thickness and character being very good at all points examined except at Prospect No. 264 on Piney Swamp Run where it has begun to thin out. In Elk District, however, which lies just west and southwest of Piney Swamp Run, this coal apparently becomes lenticular and uncertain so that it is operated at only a few points along its outcrop of many miles in the district. At the same time the Upper Freeport ("Split-six," "Davis") Coal, which is thin and of quite indifferent value in the environs of Piedmont, suddenly thickens to commercial rank and remains a valuable bed all the way to the head of the Potomac. The positive proof that the two beds have not been mistaken from Piney Swamp Run southwestward is afforded in the Hampshire Section, page 163, where both coals are present and tied by a carefully hand-leveled section to the fossiliferous Brush Creek Shale.

The **Masteller Coal Company Prospect** (No. 281 on Map II), on the west side of Piney Swamp Run 0.5 mile southwest of Hampshire, at elevation 1140′ B., had fallen shut but was reported to have found only a little coal. Its interval here above the base of the Upper Freeport is 55 feet and below the Brush Creek 60 feet, as shown by the Hampshire Section. The following prospect shows a recurrence of the coal in the vicinity of Barnum:

Kalbaugh Coal Company Prospect—No. 282 on Map II.

On the east side of North Branch of Potomac River, 0.4 mile southeast of Barnum; **Mahoning Coal**; elevation, 1265′ B.

		Ft.	In.
Sandstone, massive			
Shale, dark		4	0
Coal	1′ 1″		
Bone	0 2		
Coal	1 4	3	7
Shale, gray, pavement			

The following farm mine is located well up toward the ridge of the Allegheny Front where the rocks rise rapidly toward the top of the mountain, there being only scanty cover over the coal:

F. M. Reynolds Farm Mine—No. 283 on Map II.

On the head of a branch of Howell Run, 0.2 mile southwest of Tasker School; **Mahoning Coal**; elevation, 2515′ B.

		Ft.	In.
1. Sandstone, massive			
2. **Coal**	0′ 10″		
3. Slate, bony	0 3		
4. **Coal**	0 9		
5. **Coal**, bony	0 6		
6. **Coal**, medium-hard	1 3		
7. **Coal**, soft	2 6		
8. Shale, dark	0 1		
9. Bone	0 9	6	11
10. Shale, pavement			

A sample (No. 532R) was collected from Nos. 2, 4, 6, and 7 of section, the composition of which is published under **Mine No. 283** in the Table of Coal Analyses at the end of this Chapter.

The above mine has been the subject of much local controversy, owing to its thickness and isolation from other openings in the same bed. Many prospectors and some mining engineers have mistaken it for the Pittsburgh, or "Big Vein,"

Coal, pointing to its section and elevation as proof of its supposed identity with this valuable bed. Its principal partings, however, do not resemble those of the Pittsburgh Coal, since they are bony slate or bony coal while the partings of the Pittsburgh at all points observed in the valley are clean-cut bands of shale or slate with little or no included coal. Its elevation, also, is clearly out of line with that which should be expected for the Pittsburgh Coal along this sector of the mountain where the rocks are rising rapidly toward the summit in harmony with their general slope as shown by Map II. The positive proof that it is not Pittsburgh, however, is afforded by Openings Nos. 79, 145, 187, 188, and 302, situated along Piney Swamp Run about one mile northeast of the Reynolds opening, and by No. 302 which is quite near its line of strike. No. 79 is Elk Lick ("Barton," "Four-foot") Coal; No. 145 is the Harlem, having the fossiliferous Ames Shale just above it and thus fixing the correlations at this locality; Nos. 187 and 188 are apparently the Bakerstown; and No. 302 is without doubt the Upper Freeport ("Split-six") instead of the Little Clarksburg ("Franklin," "Dirty Nine-foot") as contended by those who support the idea that the Reynolds opening is Pittsburgh. It is quite evident from this group of openings that the Dirty Nine-foot must be expected only to the northwest of Opening No. 79 where the rocks dip down toward the basin, and it is actually found at Openings Nos. 46, 47, 48, 50, 51, 52, and 53.

Positive evidence that the Reynolds Mine is actually the Mahoning ("Six-foot"), however, is lacking. In its immediate vicinity there is no other recognizable outcrop so that stratigraphic association is available only at the openings on Piney Swamp Run. At No. 302 the Upper Freeport has an elevation of 2365′ B., being 150 feet lower than the Reynolds opening, but the Reynolds opening is apparently about 100 feet higher up the structural slope which would reduce the actual stratigraphic interval between the two mines to about 50 feet which is the approximate average at other points. There can be no question that the two openings are not the same coal since their sections are entirely different, the partings at No. 302 being pure shale or slate while at the Reynolds Mine they are bony. These bony partings are further evidence for belief that the coal is Mahoning since they are quite characteristic of it near Piedmont. The Bakerstown Coal also contains streaks of bone but its section at Mine No. 188 is quite unlike the Reynolds Mine. It is thus seen that while direct proof that the Reynolds coal is Mahoning may not be produced there is much evidence that it can be nothing else so that its correlation is fairly well established by the process of elimination.

The following mine is a small operation on the Potomac frontage, being inactive on account of the regional shut-down and not in condition for sampling:

Dean Coal Company Mine—No. 284 on Map II

On the south side of North Branch of Potomac River, 0.6 mile east of Blaine; **Mahoning Coal**; elevation, 1650′ B.

		Ft.	In.
Shale, dark			
Coal, bony	1′ 10″		
Shale, dark	0 9		
Coal, soft, good	2 10	5	5
Shale, dark, pavement			

The following is a small commercial operation which was temporarily idle:

Fortney & Piles Mine—No. 285 on Map II.

On the south side of North Branch of Potomac River, just south of Blaine; **Mahoning Coal**; elevation, 1710′ B.

		Ft.	In.
1. Sandstone, massive		40	0
2. Shale, dark		5	0
3. **Coal**, bony	0′ 10″		
4. Bone	0 11		
5. **Coal**, soft	3 0	4	9
6. Shale, pavement			

"Principal office, Blaine, W. Va.; daily capacity, 50 tons; 8 miners and 2 laborers employed; pony haulage; coal shipped east for steam fuel; butts, none; faces, none; greatest rise, northwest; I. M. Moon, Assistant Mine Foreman, authority for mine data; sample (No. 496R) collected from No. 5 of section in Main Heading, for composition of which see **Mine No. 285** in the Table of Coal Analyses at the end of this Chapter."

The following is a new operation on the Maryland side of the Potomac. At this locality both the Mahoning and Upper Freeport are opened in the same hill, the hand-leveled interval between them, base to base, being 74 feet:

Wolf Den Coal Company Mine—No. 286 on Map II.

Garrett County, Maryland; on the west side of North Branch of Potomac River, just northwest of Shallmar; **Mahoning Coal**; elevation, 1969′ B.

		Ft.	In.
Shale, dark		5	0
Coal	0′ 3½″		
Slate	0 0½		
Coal, soft	2 7		
Bone	0 2	3	1
Shale, gray, pavement			

At the following small commercial plant active mining was in progress:

Eddy Coal Company Mine—No. 287 on Map II.

On the west side of Abram Creek, 0.4 mile southeast of Harrison; Mahoning Coal; elevation, 1920′ B.

	Ft.	In.
1. Shale, dark		
2. Coal, soft	3	6
3. Shale, pavement		

"Principal office, Cumberland, Maryland; daily capacity, 50 tons; 10 miners and 4 laborers employed; mule haulage; coal shipped east for steam and domestic purposes; greatest rise, northwest; Chas. Hickey, Pit Boss, authority for mine data; sample (No. 516R) collected from No. 2 of section at face of Main Heading, for composition of which see Mine No. 287 in the Table of Coal Analyses at the end of this Chapter."

The **Brady Coal Corporation Prospect (No. 288 on Map II)**, on the south side of Abram Creek at Oakmont, had fallen shut, but according to report little coal had been found, its elevation being 1830′ B. The following is a commercial mine farther up the Potomac:

Gleason Coal & Coke Company No. 3 Mine—No. 289 on Map II.

On the south side of North Branch of Potomac River, 0.2 mile southeast of Gleason; Mahoning Coal; elevation, 2015′ B.

			Ft.	In.
1. Shale, dark				
2. Bone	0′	2½″		
3. Coal, soft	1	0		
4. Sulphur bone	0	2½		
5. Coal, soft	2	4		
6. Bone	0	2	3	11
7. Shale, pavement				

"Principal office, Frostburg, Maryland; daily capacity, 400 tons; 65 miners and 30 laborers employed, electric haulage; coal shipped east for export and steam fuel; butts, none; faces, none; greatest rise, west; Chas. H. Jones, Superintendent, authority for mine data; sample (No. 492R) collected from Nos. 3 and 5 of section in Second Right 'B', No. 1 Room, for composition of which see Mine No. 289 in the Table of Coal Analyses at the end of this Chapter."

The above mine data are combined reports for Mine No. 289 in the Mahoning and Mine No. 315 in the Upper Freeport, owned by the same company and using the same haulage and tipple. A section of the latter mine will be found on a subsequent page in this Chapter.

The **Gleason Coal and Coke Company Mine (No. 290 on Map II)**, on the south side of North Branch of Potomac River 0.2 mile south of Gleason, at elevation 2030′ B., had been abandoned and had fallen shut, no report on its section being obtained.

Mahoning ("Six-foot") Coal, Union District, Grant County.

In Union District the Mahoning Coal has not been mined, either for commercial or local use, and the few prospects which have been made at its horizon do not indicate a coal of minable thickness. Toward the headwaters of the Potomac, where it belongs entirely under drainage along the North Potomac Syncline, various borings have been made through it but show little or no coal.

The **Manor Mining and Manufacturing Company Prospect (No. 291 on Map IV)**, located in Garrett County, Maryland, on the west side of North Branch of Potomac River 0.5 mile south of Wallman, at elevation 2415′ B., had fallen shut, its thickness not being learned. There was some coal on the old dump, however, indicating a local recurrence of this seam. Here its interval above the base of the Upper Freeport, by aneroid measurement, is 35 feet.

The **S. H. Jordan Prospect (No. 292 on Map IV)**, on the south side of North Branch of Potomac River 1.1 miles northeast of Gormania, at elevation 2407′ B., had fallen shut, but according to the owner only a small amount of coal was found. The interval above the base of the Upper Freeport at this point is 67 feet by hand-level.

Coal Prospect No. 293 on Map IV, located on the west side of North Branch of Potomac River 0.5 mile south of Gormania, at elevation 2355′ B., had fallen shut, there being little evidence that much coal had been found.

Quantity of Mahoning ("Six-foot") Coal Available.

The following table, compiled by Tucker from a planimetric measurement of the outcrop on Map II, for that portion of Mineral County indicated on Figure 23, shows the probable amount of Mahoning ("Six-foot") Coal available:

Probable Amount of Mahoning ("Six-foot") Coal.

Districts.	Thickness of Coal Assumed. Feet.	Square Miles.	Acres.	Cubic Feet of Coal.	Short Tons of Coal.
Mineral County:					
Piedmont	4	6.20	3,968.0	691,384,320	27,655,373
Elk	2½	27.55	17,632.0	1,920,124,800	76,804,992
Totals		33.75	21,600.0	2,611,509,120	104,460,365

The amount of coal already mined from this bed is wholly negligible as compared to the total so that no reduction from the above figures need be made on this account.

MINABLE COALS OF THE ALLEGHENY SERIES.

UPPER FREEPORT ("SPLIT-SIX," "DAVIS") COAL.

The Upper Freeport Coal, previously described in Chapter VIII, pages 238-9, is one of the most persistent seams and by far the most valuable bed in point of tonnage in the two counties. For many years it has been commercially mined in the Potomac Valley under the name of "Lower Kittanning" Coal, the local title of "Split-six" being applied to it in the Piedmont region and the local name "Davis" being much in use near the head of the river and in Tucker County. As already stated and discussed in Chapters VII and VIII and elsewhere in this Report, the evidence requiring that this coal be correlated as the Upper Freeport instead of the Lower Kittanning is so abundant and conclusive that both the Maryland and West Virginia Surveys have adopted the change.

The Upper Freeport bed in the two counties is a soft coal, being low in volatile matter and therefore well adapted for steam fuel. It is moderately high in ash, however, since there are included beds of shale or slate which get into the shipment in spite of all precautions, and it is usually moderately high in phosphorus. Its sulphur content is variable, being sufficiently low in some localities to permit the coal to be used for by-product coke, while at others it would clearly be undesirable for such a purpose. It has been mined commercially in both Mineral and Grant Counties but there still remains a large tonnage in reserve so that the possibility of its exhaustion is remote. Its outcrop is shown on Maps II and IV, where it has been used as the basis of the structure contours, and its areal extent is also indicated in more compact form on Figures 24 and 25.

Upper Freeport, ("Split-six," "Davis") Coal, Piedmont District, Mineral County.

In Piedmont District the Upper Freeport Coal has been prospected at several points and has been used to a limited extent for local fuel but has not been commercially mined, being too thin at most points for successful competition against the Mahoning ("Six-foot") and other thicker coals.

The **Hoffa-Martin Coal Company Prospect (No. 294 on Map II)**, located on the east side of Slaughterhouse Run 1.1

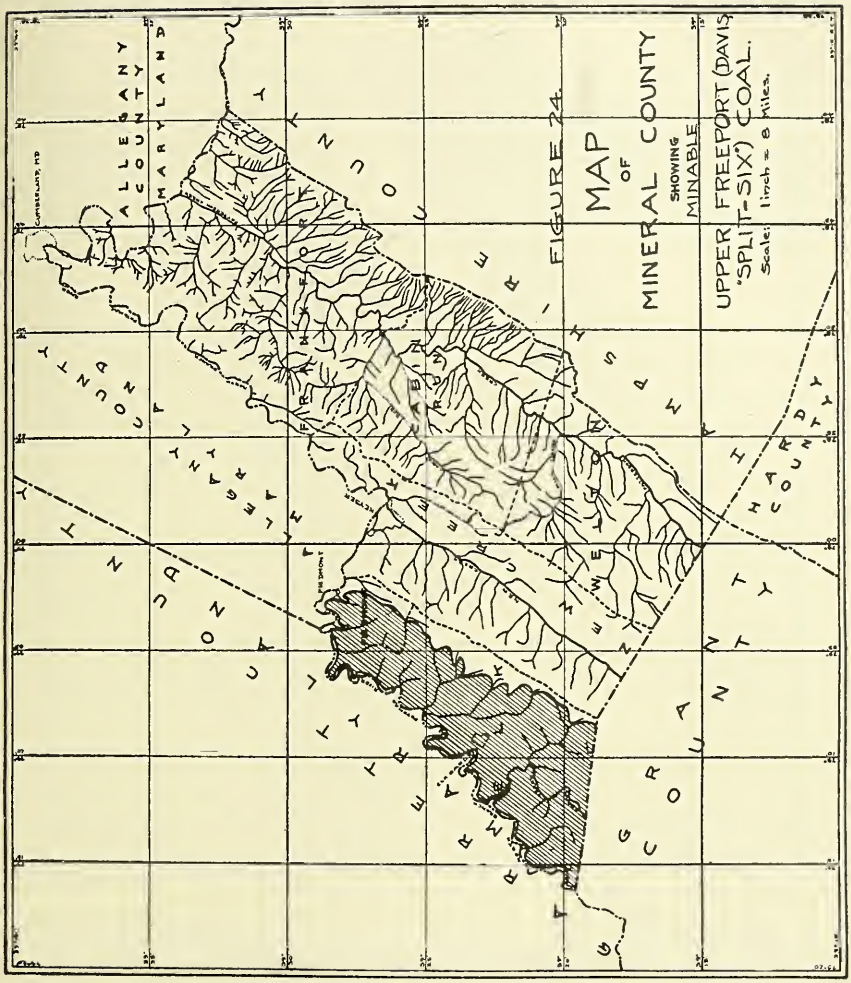


FIGURE 24.
MAP
OF
MINERAL COUNTY
SHOWING
MINABLE
UPPER FREEPORT (DAVIS
"SPLIT-SIX") COAL.
Scale: 1 inch = 8 miles.
ALLEGANY
COUNTY
MARYLAND
GARRETT
COUNTY
GRANT
COUNTY
HARDY
COUNTY
PATTERSON CREEK
NEW CREEK
WILLIAMS RIVER
SOUTH BRANCH
POTOMAC RIVER

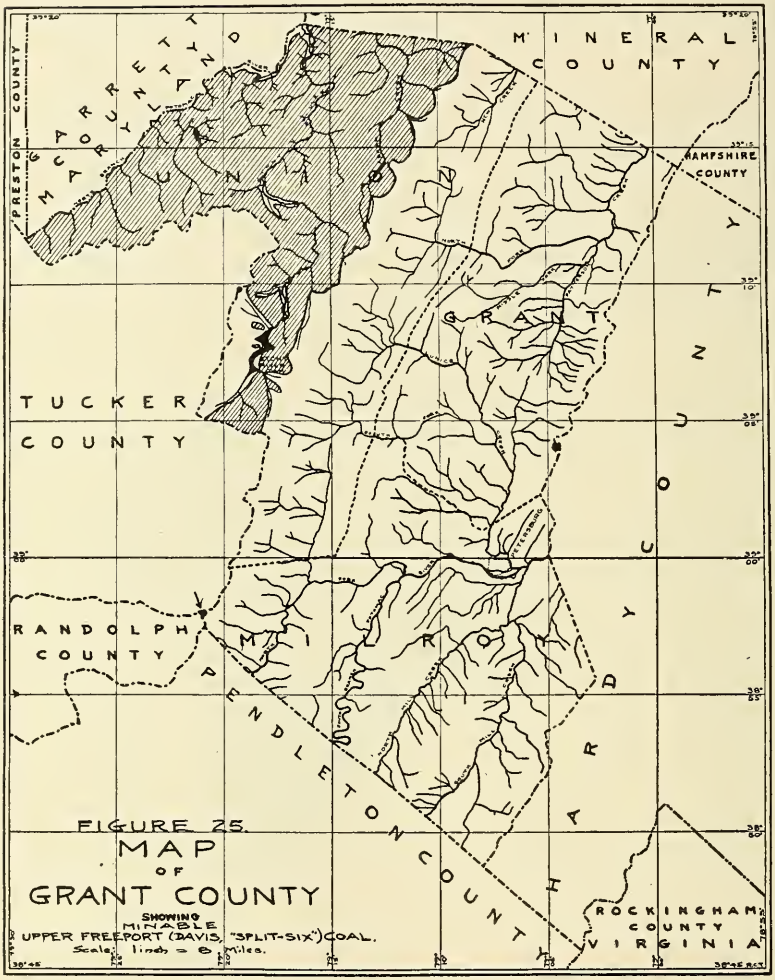


FIGURE 25.

MAP
OF
GRANT COUNTY
SHOWING
MINABLE
UPPER FREEPORT (DAVIS, "SPLIT-SIX") COAL.
Scale: 1 inch = 6 miles.

miles southeast of Piedmont, at elevation 1450′ B., had fallen shut, but apparently no great amount of coal had been found.

At the **Twin Mountain Coal Company Prospect (No. 295 on Map II),** on the mountain south of North Branch of Potomac River and 0.7 mile southeast of Piedmont, at elevation 1340′ B., there was only 1′ 4″ of coal; and in the public road from Piedmont southwestward up the mountain its horizon is again exposed at an elevation of 1212′ B., but shows only 2 feet of dark shale without any coal, as indicated in the Piedmont Section, page 157.

Coal Prospect No. 296 on Map II, located in Allegany County, Maryland, on the north side of North Branch of Potomac River 0.5 mile east of Piedmont, at elevation 1250′ B., measured 1′ 9″, as recorded in the Westernport Section, page 159.

The **Roy Friday Farm Mine (No. 297 on Map II),** in Allegany County, Maryland, on the north side of North Branch of Potomac River west of Westernport and 0.3 mile west of the mouth of Georges Creek, at elevation 1070′ B., was padlocked but the coal was reported as varying from 2 to 4 feet.

The **West Virginia Pulp & Paper Company Prospect (No. 298 on Map II),** in Allegany County, Maryland, on Franklin Hill 0.5 mile west of Piedmont, at elevation 1105′ B., had fallen shut, there being 2 feet of coal visible at the outcrop.

At the **R. J. Ross Prospect (No. 299 on Map II),** in Garrett County, Maryland, on the north side of Savage River 0.3 mile northeast of Bloomington, there was one foot of coal visible at elevation 1085′ B., the opening having partly fallen shut.

The **Baltimore and Ohio Railroad Company Exposure (No. 300 on Map II),** located on the south side of Savage River 1.1 miles northwest of Bloomington, at elevation 1190′ B., measured 5′ 5″ of coal and partings, as detailed in the Bloomington Section, page 160.

Upper Freeport ("Split-six," "Davis") Coal, Elk District, Mineral County.

In Elk District the Upper Freeport Coal suddenly thickens to a good workable seam and has been commercially mined at various points. The following plant was temporarily idle because of the regional shut-down but shows good coal:

Masteller Coal Company (New Creek No. 1) Mine—No. 301 on Map II.

On the west side of Piney Swamp Run, 0.5 mile southwest of Hampshire; **Upper Freeport Coal**; elevation, 1085′ B.

			Ft.	In.
1. Shale, sandy				
2. **Coal**, soft	1′	2″		
3. Shale, gray	0	7		
4. **Coal**, soft	1	2½		
5. Slate, bony	0	1½		
6. **Coal**, soft	1	6		
7. Bone	0	2	4	9
8. Shale, pavement				

"Principal office, Keyser, W. Va.; coal leased from The New Creek Company, of Philadelphia, Pa.; daily capacity, 200 tons; 40 miners and 10 laborers employed; gasoline motor and mule haulage; coal shipped east for steam fuel; butts, northwest; faces, southwest; greatest rise, northwest; Martin L. Watson, Superintendent, authority for mine data; sample (No. 499R) collected from Nos. 2, 4, and 6 of section in Main Heading at Lay Off, between Third and Fourth Left, for composition of which see **Mine No. 301** in the Table of Coal Analyses at the end of this Chapter."

The following is a farm opening located much farther southeast near the locality where the coal overshoots the Allegheny Front:.

George Tasker Farm Mine—No. 302 on Map II.

On the south side of Piney Swamp Run, 1 mile northeast of Tasker School; **Upper Freeport Coal**; elevation, 2365′ B.

			Ft.	In.
Shale, dark				
Coal, soft	1′	8″		
Shale, dark-gray	1	5		
Coal, soft	1	2		
Slate, dark	0	2		
Coal, soft	1	7	6	0
Shale, pavement				

At a small commercial operation having two parallel entries served by a common tipple along the Potomac frontage the following sections were secured, there being no one in charge from whom more detailed mine data could be secured. According to report this coal is owned by Campbell and Hoffa, of Piedmont, but held under lease by Mr. Warnocks:

Photo by E. E. HARRIS.

PLATE XXXIV.—Looking southward toward North Fork Mountain from western end of North Fork Gap between Petersburg and Hopeville. Sharp point in middle rear is Chimney Rock near axis of anticline from which White Medina Sandstone slopes moderately to eastward. West escarpment is marked by ridge of wooded point descending abruptly to North Fork just right of center. Topography of White Medina, Red Medina, Gray Medina, and Martinsburg Shale.

Parley Warnocks Mine (East Opening)—No. 303 on Map II.

On the south side of North Branch of Potomac River, at Warnocks; **Upper Freeport Coal**; elevation, 1150′ B.

			Ft.	In.
1. Shale, dark				
2. **Coal**, bony	0′	11″		
3. **Coal**, soft	1	3		
4. Shale, gray	1	0		
5. **Coal**, soft	1	8		
6. Shale, dark	0	1		
7. **Coal**, soft	1	7	6	6
8. Shale, pavement				

A sample (No. 500R) was collected from Nos. 3, 5, and 7 of section, the composition of which is published under **Mine No. 303** in the Table of Coal Analyses at the end of this Chapter.

Parley Warnocks Mine (West Opening)—No. 304 on Map II.

On the south side of North Branch of Potomac River, at Warnocks; **Upper Freeport Coal**; elevation, 1175′ B.

			Ft.	In.
Shale, dark				
Coal	1′	7″		
Shale, gray	1	2		
Coal	0	8		
Slate, dark	0	1		
Coal	1	0	4	6

The **Monroe Coal Mining Company Mine (No. 305 on Map II)**, located in Garrett County, Maryland, on the west side of North Branch of Potomac River opposite Barnum, at elevation 1230′ B., had been abandoned, but a measurement near the mouth of the entry showed 4′ 9″ of coal and partings, as detailed in the Barnum Section, page 165.

The two following mines, also, are on the Maryland side of the Potomac, but afford interesting sections:

Potomac Valley Coal Company Mine—No. 306 on Map II.

Garrett County, Maryland; on west side of North Branch of Potomac River, 0.2 mile southwest of Chaffee; **Upper Freeport Coal**; elevation, 1640′ B.

			Ft.	In.
Sandstone, massive, **Lower Mahoning**			20	0
Shale, dark, **Uffington**			3	0
Coal, bony	1′	2″		
Shale, gray, with streaks of **coal**	1	10		
Coal, good	2	2		
Slate, gray	0	4		
Coal	1	5	6	11
Shale, pavement				

Hamill Coal Company No. 1 Mine—No. 307 on Map II.

Garrett County, Maryland; on the north side of North Branch of Potomac River, 0.7 mile north of Kitzmiller; **Upper Freeport Coal**; elevation, 1755′ B.

			Ft.	In.
Sandstone, massive, **Lower Mahoning**			10	0
Shale, dark, **Uffington**			4	0
Coal	1′	4″		
Shale, dark	1	9		
Coal	1	4		
Shale, gray	0	4		
Coal, 1′ 0″ visible, reported	1	8	6	5

The following operation, formerly known as the **Western Maryland Coal Company**, was temporarily idle, but an entrance for inspection and sampling was afforded:

Grafton Mining Company (Split-six) Mine—No. 308 on Map II.

On the south side of North Branch of Potomac River, 0.3 mile southwest of Blaine; **Upper Freeport Coal**; elevation, 1735′ B.

			Ft.	In.
1. Shale, dark				
2. **Coal**, bony	0′	4″		
3. **Coal**, soft	1	7		
4. Shale, gray, hard	1	4		
5. **Coal**, soft	1	8	4	11
6. Shale, pavement				

"Principal office, Grafton, W. Va.; coal owned by operating company; daily capacity, 50 tons; 8 miners and 5 laborers employed; pony haulage; coal shipped east for steam fuel; greatest rise, southeast (?); I. M. Moon, Assistant Mine Foreman, authority for mine data; sample (No. 495R) collected from Nos. 3 and 5 of section in pillar on First Left, for composition of which see **Mine No. 308** in the Table of Coal Analyses at the end of this Chapter."

The following is another commercial operation which had been idle on account of the regional shut-down:

St. Cloud Coal Company (St. Cloud No. 1) Mine—No. 309 on Map II.

On the south side of North Branch of Potomac River, 0.2 mile southeast of Potomac Manor; **Upper Freeport Coal**; elevation, 1780′ B.

			Ft.	In.
1. Slate, dark				
2. **Coal**	0′	7″		
3. Shale, dark	0	6		
4. **Coal**, bony	0	6		
5. **Coal**, soft	1	5		
6. Shale, gray	2	0		
7. **Coal**	0	5		
8. Shale, dark, 0′ 1″ to	0	2		
9. **Coal**, soft	1	10		
10. Slate, bony	0	1		
11. **Coal**, soft	0	5	7	11
12. Shale, pavement				

"Principal office, Law Building, Cumberland, Maryland; coal owned by operating company; daily capacity, 75 tons; 8 miners and 4 laborers employed; mule haulage; coal shipped east for steam fuel; greatest rise, S. 15° W.; St. Cloud Ambrose, Manager, authority for mine data; sample (No. 513R) collected from Nos. 5, 7, 9, and 11 of section in First Right Heading, for composition of which see Mine No. 309 in the Table of Coal Analyses at the end of this Chapter."

The **Blaine Mining Company Mine (No. 310 on Map II)**, located in Garrett County, Maryland, on Wolfden Run of North Branch of Potomac River 0.4 mile northwest of Potomac Manor, at elevation 1835′ B., was shut down and the mine entry locked so that its section could not be secured. The following section was obtained at a large commercial operation recently installed by the W. A. Marshall interests on the Maryland side of the river:

Wolf Den Coal Company Mine—No. 311 on Map II.

Garrett County, Maryland; on the west side of North Branch of Potomac River at Shallmar; **Upper Freeport Coal**; elevation, 1895′ B.

			Ft.	In.
Shale, dark				
Coal, bony	0′	8″		
Slate, gray	0	3		
Coal, good	1	4		
Shale, gray, hard	1	0		
Coal	2	4		
Slate, gray	0	2		
Coal	1	9	7	6
Shale, pavement				

The following mine is located in West Virginia but was idle when examined. The same company operates the Mahoning Coal through the same tipple at Mine No. 287 described on page 602, to which reference is made for mining data:

Eddy Coal Company Mine—No. 312 on Map II.

On the west side of Abram Creek, 0.3 mile southwest of Harrison; **Upper Freeport Coal**; elevation, 1865′ B.

			Ft.	In.
1. Shale, dark				
2. **Coal**, soft	2′	10″		
3. Shale, dark-gray	1	2		
4. **Coal**, soft	1	6	5	6
5. Shale, pavement				

A sample (No. 517R) was collected from Nos. 2 and 4 of section in cross-cut off Main Heading, the composition of

which is published under **Mine No. 312** in the Table of Coal Analyses at the end of this Chapter.

Coal Mine No. 313 on Map II, on the south side of Abram Creek just west of Oakmont and near the locality where the Upper Freeport goes under the creek on the southeastern dip of the rocks, had been abandoned, its elevation being 1830′ B.

The **William Kitzmiller Heirs Farm Mine (No. 314 on Map II),** located on the head of Emory Run of Abram Creek 1.5 miles northeast of Hartmansville, at elevation 2670′ B., had fallen shut, there being 3 feet of coal with partings according to Edgar Shillingburg. This opening is doubtfully correlated as the Upper Freeport but it is on the steeply rising rocks near the top of the Allegheny Front so that its identity is uncertain.

The following is a commercial mine along the Potomac frontage:

Gleason Coal & Coke Company No. 1 Mine—No. 315 on Map II.

On the south side of North Branch of Potomac River, 0.2 mile south of Gleason; **Upper Freeport Coal**; elevation, 1970′ B.

			Ft.	In.
1. Shale, dark				
2. **Coal,** soft	1′	8″		
3. Shale, gray	1	5½		
4. **Coal,** soft	0	11		
5. Slate, black	0	1		
6. **Coal,** soft	1	4		
7. Slate, black	0	1½		
8. **Coal,** soft	1	6	7	1

A sample (No. 493R) was collected from Nos. 2, 4, 6, and 8 of section in Second North Air-Course off Fifth Right, the composition of which is published under **Mine No. 315** in the Table of Coal Analyses at the end of this Chapter. Other items concerning this mine are published under the description of Mine No. 289, page 602, the Mahoning seam being operated by the same company through a joint tipple.

At the **Hubbard Coal Mining Company Mine (No. 316 on Map II),** located in Garrett County, Maryland, on the north side of North Branch of Potomac River 0.3 mile north of Hubbard, at elevation 2215′ B., the coal, with partings, measured 8′ 3″, as detailed in the Hubbard Section, page 172.

The following is a farm mine from which coal has been wagoned to the railroad at Schell:

Schell Coal Company Mine—No. 317 on Map II.

On the east side of North Branch of Potomac River, 0.2 mile northeast of Schell; **Upper Freeport Coal**; elevation, 2270′ B.

			Ft.	In.
1.	Sandstone, massive			
2.	Shale, dark		5	0
3.	**Coal**, medium-soft	2′ 0″		
4.	Shale, gray, hard	1 11		
5.	**Coal**	0 5		
6.	Shale, gray	1 1		
7.	**Coal**	0 5½		
8.	Slate, dark	0 2		
9.	**Coal**	0 5½		
10.	Slate, dark	0 2		
11.	**Coal**	0 7	7	3
12.	Shale, pavement			

A sample (No. 477R) was collected from Nos. 3, 5, 7, 9, and 11 of section, the composition of which is published under **Mine No. 317** in the Table of Coal Analyses at the end of this Chapter.

The following mine, located slightly eastward from the Blackwater Anticline, had formerly been operated by unknown parties but was apparently abandoned on account of the excessive shale and slate partings:

Coal Mine (Abandoned)—No. 318 on Map II.

On the east side of North Branch of Potomac River, 0.5 mile southeast of Schell; **Upper Freeport Coal**; elevation, 2255′ B.

		Ft.	In.
Sandstone, massive			
Shale, dark		5	0
Coal	1′ 1″		
Shale, dark-gray	4 6		
Coal	0 5		
Slate, dark	0 2		
Coal	0 8		
Bone	0 1		
Coal	0 8	7	7
Shale, pavement			

The large shale parting shown near the top of the above section is an apparent thickening of the middle shale which gives the Upper Freeport of the valley the "Split-six" designation. From this point northwestward up the river to the locality where the coal finally goes under drainage east of Gormania the abnormal shale parting continues, being sometimes as much as eight or ten feet thick. The following small commercial operation, which was closed down, apparently represents the lower bench of the coal:

Glade Run Coal Company Mine—No. 319 on Map II.

On the south side of North Branch of Potomac River, 0.8 mile south of Schell; **Upper Freeport Coal**; elevation, 2295′ B.

			Ft.	In.
Shale, dark				
Coal	0′	5″		
Shale, gray	0	4		
Coal	2	5	3	2
Shale, pavement				

The above coal was reported as being owned by the Arnold Coal Company but held by the Glade Run Coal Company under an operating lease. No foreman was available to give more detailed information and an entrance to the face for sampling was not considered advisable.

Upper Freeport, ("Split-six," "Davis") Coal, Union District, Grant County.

In Union District there is a large amount of Upper Freeport Coal but there is a much smaller frontage of outcrop along the railroad so that there are fewer commercial mines than in Elk District.

At the **E. H. Hanlin Prospect (No. 320 on Map IV)**, located on the east side of Little Creek 1.2 miles northeast of Bismarck and well up against the Allegheny Front, the coal was reported to have been found at a depth of 35 feet in a well dug for water, making its elevation 2885′ B., but the hole did not go entirely through the seam.

On the same property the coal was once operated for local fuel by a shallow shaft which has now been abandoned, but the owner reports the following approximate section from the old shaft mouth downward:

E. H. Hanlin Shaft Mine (Abandoned)—No. 321 on Map IV.

On the east side of Little Creek, 1.2 miles northeast of Bismarck; **Upper Freeport Coal**; elevation, 2900′ B.

	Ft.	In.
Sandstone	16	0
Slate, black	2	0
Coal, with three streaks of slate or shale, reported	6	0

In the same neighborhood the coal is operated for local fuel at the following slope which goes westward down the steeply dipping coal strata toward the Stony River Syncline:

Sanford Hanlin Farm Mine—No. 322 on Map IV.

On the west side of Little Creek, 0.5 mile northeast of Bismarck; **Upper Freeport Coal**; elevation, 2835′ B.

			Ft.	In.
1. Sandstone, massive				
2. Slate, black			2	0
3. **Coal**, soft	0′	11″		
4. Slate, dark	0	3		
5. **Coal**, soft	0	6		
6. Shale, gray	0	11		
7. **Coal**, soft	1	1	3	8
8. Shale, pavement				

A sample (No. 480R) was collected from Nos. 3, 5, and 7 of section, the composition of which is published under **Mine No. 322** in the Table of Coal Analyses at the end of this Chapter.

The following is another farm mine which operates at a disadvantage on account of the dip:

Lloyd Kitzmiller Farm Mine—No. 323 on Map IV.

On the west side of Little Creek, 0.7 mile southeast of Bismarck; **Upper Freeport Coal**; elevation, 2940′ B.

			Ft.	In.
Slate, black				
Coal, soft	0′	8″		
Shale, gray	0	4		
Coal	0	11		
Slate, black	0	1		
Coal, soft	2	0		
Slate, black	0	1		
Coal, soft	1	4	5	5
Shale, pavement				

The **Edward B. Smith Farm Mine (No. 324 on Map IV)**, on the head of Abram Creek 1.2 miles southeast of Bismarck, at elevation 3110′ B., had fallen shut, but according to Earl Hanlin the coal was 5 feet thick, with two slate partings.

On the waters of Stony River the coal has been opened at various points and usually shows a good thickness, although having several shale partings. At the following opening it was mined many years ago by the Beaver Creek Lumber Company for use on its logging trains but since the removal of the railroad the place has been abandoned. Fortunately the old mine had been reopened for exhibition purposes by the present owners so that the following section was secured at the face of the entry, about 200 feet from the mouth:

Herr and Company Mine (Abandoned)—No. 325 on Map IV.

On the south side of Stony River, 0.6 mile above Fourmile Run and 3.2 miles west of Bismarck; **Upper Freeport Coal**; elevation, 3110′ B.

			Ft.	In.
1. Sandstone				
2. Shale, dark			5	0
3. **Coal**	1′	2″		
4. Bone	0	4		
5. **Coal**	0	7		
6. Slate, dark	0	3		
7. **Coal**	0	9		
8. Shale, dark	0	5		
9. **Coal**	0	7½		
10. Slate, dark	0	0½		
11. **Coal**	0	11		
12. Slate, dark	0	1		
13. **Coal**	2	3	7	5
14. Shale, pavement (gentle eastward dip)				

A sample (No. 482R) was collected from Nos. 3, 5, 7, 9, 11, and 13 of the section, the composition of which is published under **Mine No. 325** in the Table of Coal Analyses at the end of this Chapter.

The following is a natural exposure of the coal in the bluff of Stony River:

Herr and Company Exposure—No. 326 on Map IV.

On the north side of Stony River, 2.8 miles west of Bismarck; **Upper Freeport Coal**; elevation, 3045′ B.

			Ft.	In.
Sandstone, massive, cliff, **Lower Mahoning**			40	0
Slate, black, cannel			2	0
Coal, slaty	1′	8″		
Coal, soft	0	9		
Slate, dark	0	4		
Coal, soft	0	8		
Slate, 0′ 0½″ to	0	1		
Coal, soft	0	8		
Slate, bony	0	3		
Coal, soft	0	11		
Slate, black	0	2		
Coal	0	6½		
Slate, dark	0	2½		
Coal, soft	2	6	8	9
Fire clay shale, pavement (dip southeast)				

The following prospect, on the opposite side of the river affords another good section of the coal:

Herr and Company Prospect—No. 327 on Map IV.

On the south side of Stony River, 2.6 miles west of Bismarck; **Upper Freeport Coal**; elevation, 3050′ B.

			Ft.	In.
Shale, dark				
Coal, soft	1′	7″		
Slate, black	0	3		
Coal, soft	0	9		
Shale, dark-gray	1	2		
Coal, soft	1	1		
Slate, black	0	1		
Coal, soft	1	5		
Slate, black	0	3		
Coal, soft	2	2	8	9
Slate, pavement				

The following exposure is at one of the falls of Stony River where the coal goes under drainage on the southeast dip toward the Stony River Syncline:

Herr and Company Exposure—No. 328 on Map IV.

At falls of Stony River, 2.4 miles westward from Bismarck; **Upper Freeport Coal**; elevation, 3010′ B.

			Ft.	In.
1. Sandstone, massive, makes falls and rapids, **Lower Mahoning**			20	0
2. Slate, cannel			1	6
3. **Coal**, bony	1′	3″		
4. Slate, black	0	7		
5. **Coal**, 1′ 7″ visible, reported	5	0	6	10

At No. 5 of the above section there was only 1′ 7″ of coal visible, but according to Otto Sittig, local agent for Herr and Company, this bench contains 5 feet of coal which has been mined at dry times for local fuel.

The following prospect, located close up against the Allegheny Front, had fallen shut but its section is reported as follows by J. W. Mahaffey, a resident, who made the opening:

Benj. F. Hanlin Prospect—No. 329 on Map IV.

On the head of Laurel Run of Stony River, 0.2 mile south of Grassy Ridge School; **Upper Freeport Coal**; elevation, 3420′ B.

			Ft.	In.
Coal, reported	2′	4″		
Slate, black, reported	0	3		
Coal, reported	1	4		
Slate, black, reported	0	4		
Coal, reported	3	7	7	10

The following is a prospect dug down the steep dip of the coal in the low land along the river where the outcrop has no cover and where the sample taken was from dirty and oxidized coal:

Chambers Tract Prospect—No. 330 on Map IV.

On the west side of Helmick Run of Stony River, 2.4 miles northeast of Stony River Dam; **Upper Freeport Coal**; elevation, 3275′ B.

			Ft.	In.
1. Soil				
2. Slate, dark			1	0
3. **Coal**, soft	2′	2″		
4. Slate, dark	0	3		
5. **Coal**, soft	0	11		
6. Slate, dark-gray	0	8		
7. **Coal**, soft	0	4		
8. Slate, dark	0	2		
9. **Coal**, soft	1	3		
10. **Coal**, concealed by water, reported	1	4	7	1
11. Pavement				

A sample (No. 485R) was collected from Nos. 3, 5, 7, and 9 of section, the composition of which is published under **Mine No. 330** in the Table of Coal Analyses at the end of this Chapter.

At the following prospect which runs westward on the dip and was full of water, the Babcock Lumber and Boom Company was beginning the installation of a mine to furnish fuel for its new railroad line which passes around the Stony River Dam and thence to the Allegheny Front. A section was secured at the mouth of the entry but sampling at the face was impossible:

Parsons Pulp and Lumber Company Prospect—No. 331 on Map IV.

On west side of Helmick Run of Stony River, 1.1 miles east of Stony River Dam; **Upper Freeport Coal**; elevation, 3375′ B.

			Ft.	In.
1. Shale, dark			10	0
2. Slate, black, bony			0	6
3. **Coal**, soft	2′	4″		
4. Slate, dark	0	6		
5. **Coal**	0	9		
6. Shale, dark-gray, 1′ 0″ to	0	3		
7. **Coal**, soft	2	9	6	7
8. Shale, pavement				

The following prospect appears to represent only the lower portion of the seam, No. 1 being probably the same as No. 4 in the above opening:

Davis Coal & Coke Company No. 15 Prospect—No. 332 on Map IV.

On the east side of Stony River, 1.6 miles north of Stony River Dam; **Upper Freeport Coal**; elevation, 3280′ B.

			Ft.	In.
1. Shale, dark				
2. **Coal**, soft	1′	3″		
3. Slate, dark	0	1		
4. **Coal**, soft	2	4	3	8
5. Shale, pavement				

A sample (No. 484R) was collected from Nos. 2 and 4 of section, the composition of which is published under **Mine No. 332** in the Table of Coal Analyses at the end of this Chapter.

The **Davis Coal and Coke Company Exposure (No. 333 on Map IV)**, located in the bed of Stony River just below the huge dam of the West Virginia Pulp and Paper Company, at an elevation of 3365′ B., would appear from its position to be at the horizon of the Upper Freeport Coal, although proof in support of such a belief is lacking. Here there is visible some coal underlaid by flinty and plastic fire clay but there is no clear exposure of the strata.

The following mine, which is now abandoned, was once operated by the Rumbarger Lumber Company but was abandoned by that company when its railroad track was removed from the Stony River Valley many years ago:

Davis Coal & Coke Company (Rumbarger) Mine (Abandoned)—No. 334 on Map IV.

Seven-tenths mile southwest of Stony River Dam; **Upper Freeport Coal**; elevation, 3410′ B.

			Ft.	In.
1. Shale, dark				
2. **Coal**, soft	2′	6″		
3. Slate, bony	0	4		
4. **Coal**, soft	0	8		
5. Shale, gray	0	6		
6. **Coal**, soft	0	6		
7. Slate, dark	0	1		
8. **Coal**, soft	0	11		
9. Slate, bony	0	2		
10. **Coal**, soft	1	8	7	4
11. Pavement				

"Section about 75 feet under cover in somewhat rotten coal; 12 feet by hand-level above the level of Stony River Dam; dips gently to southeast; sample (No. 483R) collected from Nos. 2, 4, 6, 8, and 10 of section, for the composition of which see **Mine No. 334** in the Table of Coal Analyses at the end of this Chapter."

The **Davis Coal and Coke Company No. 11 Prospect (No. 335 on Map IV)**, located on the east side of Stony River 1 mile south of the dam, at elevation 3410′ B., had fallen shut, there being no section obtainable. The following section was secured at the mouth of another opening:

Davis Coal & Coke Company No. 1 Prospect—No. 335A on Map IV.

On the south side of Wymer Run of Stony River, 1.9 miles south of Stony River Dam; **Upper Freeport Coal**; elevation, 3435′ B.

		Ft.	In.
Sandstone, massive			
Shale, dark		10	0
Coal, soft	2′ 9″		
Slate, dark	0 3		
Coal, soft	0 9		
Shale, gray	0 10		
Coal, soft	2 7	7	2
Shale, pavement (dip northwest)			

Several other prospects have been made by the Davis Coal and Coke Company in the region surrounding the dam but none of the others could be found, even with the help of a guide, since the region was overgrown with briers and brush. The company generously placed at the disposal of the writer its records of prospects and borings, affording an opportunity for making conclusions but without permission for detailed publication. All this information points to the existence of a large body of thick coal at the Upper Freeport horizon.

Along the Potomac frontage the following is an abandoned entry on the Maryland side and just just west of the axis of the Blackwater Anticline; only the lower bench appears to have been exploited:

Manor Mining and Manufacturing Company Mine (Abandoned)—No. 336 on Map IV.

Garrett County, Maryland; on the west side of North Branch of Potomac River, 0.5 mile southwest of Wallman; **Upper Freeport Coal**; elevation, 2380′ B.

		Ft.	In.
Shale, dark			
Coal	0′ 10″		
Slate, black	0 2		
Coal	1 3		
Coal, bony	0 3		
Coal, slightly slaty	1 4	3	10
Shale, gray		3	0

At the following mine both benches of the coal have been prospected, there being a central parting of 8 feet which is near the maximum found in this region:

Aberdeen Coal Company Mine—No. 337 on Map IV.

Garrett County, Maryland; on the north side of North Branch of Potomac River, 0.2 mile north of Steyer; **Upper Freeport Coal;** elevation, 2375′ B.

			Ft.	In.
Shale, dark			3	0
Coal	0′	5″		
Slate, gray	0	2		
Coal	0	9		
Slate, bony	1	3		
Coal	1	4	3	11
Shale, gray and sandy			8	0
Coal	0′	4½″		
Slate, black	0	1½		
Coal	0	10		
Slate, bony	1	0		
Coal, with some knife-edge slates	1	10	4	2
Shale, pavement				

The **J. W. Brock Prospect (No. 338 on Map IV),** on the south side of North Branch of Potomac River 0.6 mile southwest of Steyer, at elevation 2400′ B., had fallen shut, its thickness not being learned. The following is another prospect showing the entire section of the coal:

John and Pat Fahey Prospect—No. 339 on Map IV.

On the south side of North Branch of Potomac River, 0.7 mile southwest of Steyer; **Upper Freeport Coal;** elevation, 2380′ B.

			Ft.	In.
Shale, dark			3	0
Coal	0′	9½″		
Slate, dark	0	2½		
Coal	1	1		
Shale, dark	1	7		
Coal	1	1	4	9
Shale, gray, to top of lower bench			3	6
Coal	0′	11″		
Slate, dark	0	3		
Coal	1	5		
Shale, dark	1	5		
Coal	0	9		
Bone	0	3		
Coal	0	8	5	8
Shale, pavement				

The following mine was in active operation:

S. H. Jordan Mine—No. 340 on Map IV.

On the south side of North Branch of Potomac River, 1.2 miles northeast of Gormania; **Upper Freeport Coal**; elevation, 2340′ B.

			Ft.	In.
1. Slate, dark				
2. **Coal**, soft	0′	10″		
3. Slate, black	0	1		
4. **Coal**	1	2½		
5. Bone	0	6½		
6. **Coal**	0	1½		
7. Shale, dark, hard	0	7½		
8. **Coal**, soft	1	2	4	7
9. Slate, dark, followed by big binder				

"Principal office, Keyser, W. Va.; coal owned by operator; daily capacity, 50 tons; 11 miners and 6 laborers employed; gasoline motor haulage; coal shipped east for steam fuel; butts, none; faces, none; greatest rise, southeast; J. T. Jordan, Superintendent, authority for mine data; sample (No. 491R) collected from Nos. 2, 4, and 8 of section in Second Right Air-Course, for composition of which see **Mine No. 340** in the Table of Coal Analyses at the end of this Chapter."

The above section is that of the upper bench, but in some parts of this mine both benches are operated, the following being a complete section measured where everything is exposed:

			Ft.	In.
1. Shale, dark				
2. **Coal**	1′	0″		
3. Bone	0	1½		
4. **Coal**	1	3½		
5. Bone	0	7		
6. **Coal**	0	2		
7. Shale, gray	0	8		
8. **Coal**	1	8	5	6
9. Shale, gray, 2′ 0″ to			2	6
10. **Coal**	1′	9″		
11. Bone	0	7		
12. Shale, gray	0	4		
13. **Coal**	1	8	4	4
14. Shale, pavement				

Coal Mine No. 341 on Map IV, located in Garrett County, Maryland, on the north side of North Branch of Potomac River, just west of the mouth of Glade Run and 1.2 miles northeast of Gormania, at elevation 2330′ B., had been abandoned, no section being obtainable. This is just opposite the Jordan mine, both operations being barely above the flood-plain of the river. A short distance westward the coal goes entirely under drainage on the northwestern dip.

At the **McCullough Coal and Coke Company Mine (No. 342 on Map IV)**, located in Garrett County, Maryland, on the west side of North Branch of Potomac River, 0.4 mile south of Gormania, a shaft was once sunk with the evident intention of mining the Upper Freeport Coal, but it does not appear as though much, if any, coal was ever mined at this plant and no further information could be obtained about it locally. The shaft mouth is at elevation 2350′ B., making the probable depth to the coal about 100 feet.

The following operation, which succeeded the Buffalo Creek-Cumberland Coal Company, reaches the coal by slope on the waters of Buffalo Creek west of the Blackwater Anticline. The plant, which is well equipped, is one of the largest in the valley:

Emmons Coal Mining Company of W. Va. (Culpepper) Mine —No. 343 on Map IV.

On Little Buffalo Creek, 1 mile southeast of Bayard; **Upper Freeport Coal**; elevation, 2530′ B.

			Ft.	In.
1. Shale, dark				
2. **Coal**, soft	1′	4″		
3. **Coal**, bony	1	1		
4. Shale, dark-gray	0	9		
5. **Coal**, soft	2	10		
6. Bone	0	5		
7. **Coal**, soft	1	1	7	6
8. Shale, pavement				

"Principal office, Land Title Building, Philadelphia, Pennsylvania; coal owned partly by operating company and partly by Reece and Clark; daily capacity, 800 tons; 184 miners and 90 laborers employed; electric haulage; coal shipped east for steam fuel; butts, none; faces, none; greatest rise, southeast; James Strachan, Superintendent, authority for mine data; sample (No. 490R) collected from Nos. 2, 5, and 7 of section in Dip Heading, for composition of which see **Mine No. 343** in the Table of Coal Analyses at the end of this Chapter."

The **Davis Coal and Coke Company Prospect (No. 344 on Map IV)**, located on Little Buffalo Creek 1.3 miles southeast of Bayard, at elevation 2590′ L., had fallen shut, no report on its thickness being obtained.

Just southwest of Henry the Davis Coal and Coke Company formerly operated the Upper Freeport Coal by a deep shaft but at the present time mining is confined to the Bakerstown seam which is removed through the same pit. The depth to the Upper Freeport here is near 400 feet. The following section, measured by A. P. Brady and published in Volume II, page 488, of the West Virginia Geological Survey, gives interesting data on this old mine:

Davis Coal and Coke Company Mine (Inactive)—No. 345 on Map IV.

On south side of North Branch of Potomac River, just southwest of Henry; **Upper Freeport Coal**; elevation at surface, 2660′ B.; depth to coal, about 400 feet.

			Ft.	In.
Sandstone				
Fire clay				
Coal	2′	1″		
Slate	0	10		
Coal	4	2		
Bone coal	0	1	7	2

"Butts run S. 54¼° W.; faces, S. 35¾° E.; greatest rise, S. 54° E."

A sample collected by Mr. Brady showed the following analysis, according to B. H. Hite, formerly Chemist of the Survey:

	Per cent.
Moisture	0.65
Volatile Matter	18.46
Fixed Carbon	68.64
Ash	12.25
Total	100.00
Sulphur	2.21
Phosphorus	0.014

The same company operates another large shaft mine at Kempton, Maryland, the workings of which are partly in Grant County. Information secured at this plant and previously published in the Tucker County Report of the Survey, pages 383-384, is as follows:

Davis Coal and Coke Company No. 42 Mine—No. 346 on Map IV.

Garrett County, Maryland; on North Branch of Potomac River at Kempton; **Upper Freeport Coal**; elevation of coal, 2306′ L.

			Ft.	In.
1. Draw slate, reported			2	0
2. **Coal**, bony, soft, reported	0′	2″		
3. **Coal**, soft, columnar	2	0½		
4. Slate, black	0	2		
5. **Coal**, soft, columnar	3	0½	5	5
6. Slate, pavement				

"Principal office, Continental Trust Building, Baltimore, Maryland; daily capacity, 700 tons; 103 miners and 95 laborers employed; electric haulage; coal shipped east for by-product coke manufacture; greatest rise, northwest; sample (No. 387R) collected from Nos. 3 and 5 of section in E-1 Heading off Main Entry, 4500 feet from shaft bottom by D. B. Reger; R. S. Taylor, Mine Clerk, authority for mine data."

Photo by E. E. HARRIS.

PLATE XXXV.—View looking southwestward up valley of North Fork of South Branch of Potomac River from western end of North Fork Gap, boulders of White Medina being visible along road in foreground. There is a sharp dip toward right with Helderberg in part of bottom ground. Allegheny Front is faintly visible in extreme right background.

The composition of the above sample is published under **Mine No. 346** in the Table of Coal Analyses at the end of this Chapter. The above shaft is 420 feet deep. The entire section of the coal is not mined at the point where the sample was taken, as shown by the following measurement in the Main Heading about 75 feet above Main "B":

			Ft.	In.
1. Draw slate				
2. Coal, bony	0′	2″		
3. Coal, soft, columnar	1	10		
4. Slate, dark	0	2		
5. Coal, soft, columnar	3	1		
6. Shale, gray	1	6		
7. Coal	0	1½		
8. Slate, bony	0	6		
9. Coal, soft	2	2		
10. Shale, gray	0	1½		
11. Coal	1	0	10	8
12. Slate, pavement				

From a comparison of the two sections it is evident that the first six members are identical.

Quantity of Upper Freeport ("Split-six," "Davis") Coal Available.

The following table, compiled by Tucker from a planimetric measurement of the outcrops on Maps II and IV, shows the probable amount of Upper Freeport Coal in the two counties:

Probable Amount of Upper Freeport ("Split-six," "Davis) Coal.

Districts.	Thickness of Coal Assumed. Feet.	Square Miles.	Acres.	Cubic Feet of Coal.	Short Tons of Coal.
Mineral County:					
Piedmont	2	6.50	4,160.0	362,419,200	14,496,768
Elk	4	44.90	28,736.0	5,006,960,640	200,278,426
Totals		51.40	32,896.0	5,369,379,840	214,775,194
Grant County:					
Milroy	3	0.03	19.2	2,509,056	100,362
Union	5	107.77	68,972.8	15,022,275,840	600,891,034
Totals		107.80	68,992.0	15,024,784,896	600,991,396
Grand Totals for Area		159.20	101,888.0	20,394,164,736	815,766,590

The amount of Upper Freeport Coal already mined is wholly negligible as compared to the total, so that no reduction from the above figures need be made on this account.

UPPER KITTANNING COAL.

The Upper Kittanning Coal, previously described in Chapter VIII, page 242, and coming about 100 feet below the Upper Freeport, is of minable thickness and purity in portions of Piedmont and Elk Districts, Mineral County, where it is from 2 to 3 feet in thickness and usually, although not always, free from slate partings. In former reports on the Potomac region and in trade circles it does not appear that this coal has been designated by any generally accepted title. To a limited extent it has been known as the Clarion seam but the same name has much more often been applied to the true Lower Kittanning Coal of the valley. Owing to the close resemblance of the two beds it is quite probable that the coal now under discussion has usually been mistaken for the Lower Kittanning and therefore locally called the Clarion. Both beds are visible, however, on the Maryland side of the Potomac east of Savage River and on the West Virginia side the Upper Kittanning is exposed in a cut where the Western Maryland Railway passes under the Baltimore and Ohio just east of Bloomington while the Lower Kittanning is visible at the "Y" of the former road a few hundred feet eastward, there being a heavy sandstone between them which is traceable through this distance.

The restricted region in which the Upper Kittanning Coal has a general minable thickness is indicated on Figure 26 and on Map II its outcrop is delineated for the same area. There are doubtless points within this area where the coal is too thin for exploitation so that more particular information should be sought in detailed sections. This coal has not been mined commercially in the county but is being operated just across the Potomac in Garrett County, Maryland.

Upper Kittanning Coal, Piedmont District, Mineral County.

In Piedmont District the Upper Kittanning Coal appears to be of value only in the northern end, next to the Potomac River, there being some good exposures in this locality, the following being one of them:

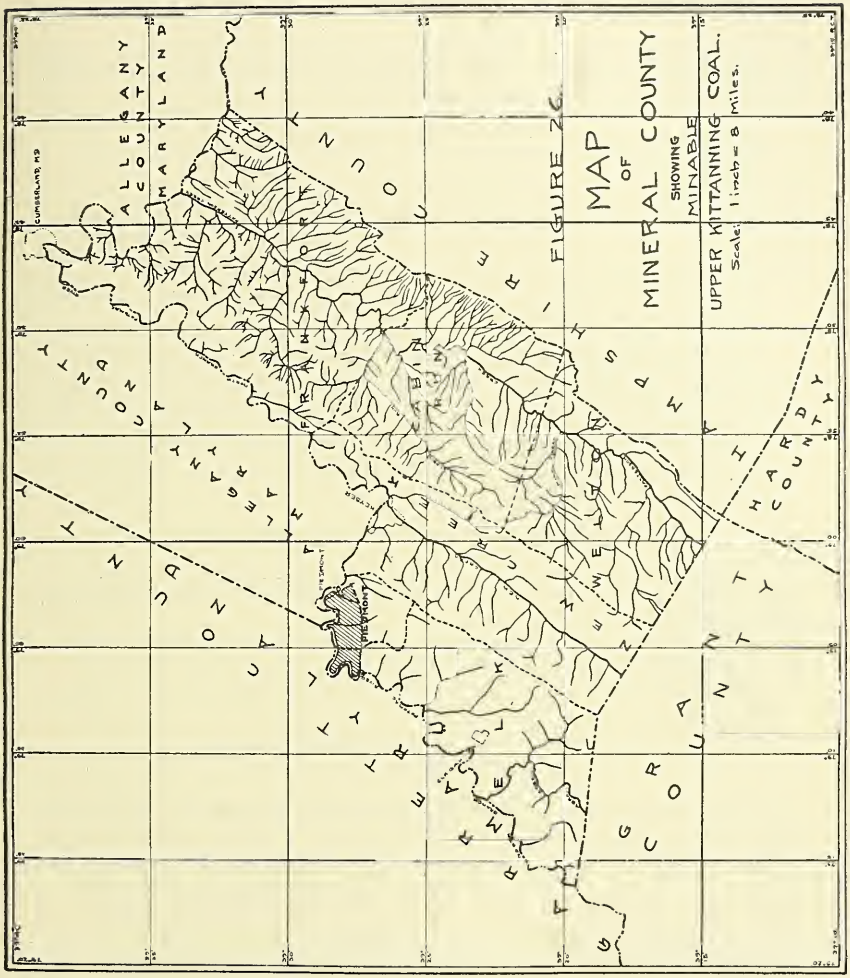


FIGURE 26
MAP
OF
MINERAL COUNTY
SHOWING
MINABLE
UPPER KITTANNING COAL.
Scale: 1 inch = 8 miles.
ALLEGANY COUNTY MARYLAND
CUMBERLAND, MD
MINERAL COUNTY
HARDY COUNTY
GRANT COUNTY
PENDLETON COUNTY
POTOMAC RIVER
NORTH FORK MOUNTAIN
PATTERSON CREEK MOUNTAIN
PATTERSON CREEK
SOUTH BRANCH MOUNTAIN
SOUTH BRANCH OF POTOMAC
NEW CREEK MOUNTAIN
NEW CREEK
KEYSER
PETERSBURG

Western Maryland Railway Exposure—No. 353 on Map II.

On the west side of North Branch of Potomac River, just south of the Baltimore and Ohio Railroad viaduct, 0.1 mile south of Franklin; **Upper Kittanning Coal**; elevation, 985′ B.

			Ft.	In.
Sandstone, massive, cliff, **Lower Freeport**			20	0
Shale, sandy			5	0
Coal	1′	3″		
Coal, bony	0	3		
Coal	1	0	2	6
Fire clay shale			8	0
Sandstone, to grade 2′ 0″ Sandstone, to river 15 0 } **East Lynn**			17	0

At **Coal Exposure No. 354 on Map II**, in Allegany County, Maryland, on the north side of North Branch of Potomac River 0.2 mile north of Franklin Station, at elevation 985′ B., the coal varies from 2′ 0″ to 2′ 6″ thick, as detailed in the Luke Section, page 158. The following is another prominent exposure in the same locality:

Coal Exposure—No. 355 on Map II.

Allegany County, Maryland; on north side of North Branch of Potomac River, 0.3 mile northeast of Bloomington; **Upper Kittanning Coal**; elevation, 1003′ B.

	Ft.	In.
Sandstone, massive, **Lower Freeport**	40	0
Shale, dark-gray, with plant fossils	5	0
Coal	2	3
Slate, black, bony	1	0
Fire clay shale, with ferruginous limestone nodules, to road, **Johnstown Limestone**	17	0

The **Baltimore and Ohio Railroad Company Exposure (No. 356 on Map II)**, at the old Everette Tunnel which is now an open cut, located on the south side of Savage River, Garrett County, Maryland, 2.2 miles northwest of Bloomington, at elevation 1350′ B., shows 1′ 0″ of this coal coming 40 feet, by hand-level, above the Lower Kittanning.

The following is a small commercial plant which was temporarily inactive, owing to the regional shut-down:

H. P. Brydon & Bro., Inc., Mine—No. 357 on Map II.

Garrett County, Maryland; on the north side of North Branch of Potomac River, 0.4 mile northeast of Hampshire; **Upper Kittanning Coal**; elevation, 990′ B.

	Ft.	In.
1. Sandstone, massive, **Lower Freeport**	20	0
2. Shale, sandy	3	0
3. **Coal**, good	2	6
4. Slate, black, sandy shale, and concealed	15	0
5. Sandstone, massive, **East Lynn**, to river	5	0

A sample (No. 464R) was collected from No. 3 of section, the composition of which is published under **Mine No. 357** in the Table of Coal Analyses at the end of this Chapter. The East Lynn Sandstone at this point has reptile tracks on its top, as described elsewhere in this Report.

Upper Kittanning Coal, Elk District, Mineral County.

In Elk District the Upper Kittanning Coal appears to be of value only in the extreme northern end, although there are sporadic occurrences elsewhere that exhibit some fairly good coal. The three following localities are along the Potomac River frontage:

Western Maryland Railway Exposure—No. 358 on Map II.

On the south side of North Branch of Potomac River, 0.3 mile west of Hampshire; **Upper Kittanning Coal**; elevation, 1035′ B.

		Ft.	In.
Sandstone, shaly		10	0
Shale, sandy		5	0
Coal	1′ 2″		
Slate, dark	0 1		
Coal	1 2	2	5
Fire clay shale		5	0
Sandstone, **East Lynn**, to grade		5	0

Western Maryland Railway Exposure—No. 359 on Map II.

On the east side of North Branch of Potomac River, 0.5 mile northeast of Warnocks; **Upper Kittanning Coal**; elevation, 1085′ B.

		Ft.	In.
Fire clay shale, ferriferous		25	0
Sandstone, massive		15	0
Coal	1′ 4″		
Slate, dark	0 1		
Coal	0 6	1	11
Fire clay shale		4	0
Sandstone, massive		4	0
Fire clay shale, to grade		5	0
Concealed		15	0
Sandstone, massive, **East Lynn**, in river			

Western Maryland Railway Exposure—No. 360 on Map II.

On the east side of North Branch of Potomac River, 0.4 mile northeast of Warnocks; **Upper Kittanning Coal**; elevation, 1090′ B.

	Ft.	In.
Shale, dark		
Coal	0	6
Fire clay shale, ferriferous, to grade	15	0

The **Hamill Coal Company Prospect (No. 361 on Map II)**, located in Garrett County, Maryland, on the west side of North Branch of Potomac River 0.5 mile north of Kitz-

miller, at elevation 1690′ B., had fallen shut but the coal was reported 2′ 8″ thick.

The **Western Maryland Railway Exposure (No. 362 on Map II)**, on the east side of North Branch of Potomac River 0.2 mile northeast of Blaine, at elevation 1630′ B., measured 2′ 1″, with partings, as detailed in the Elk Garden Section, page 170.

The three following exposures exhibit a considerable amount of coal but it appears to be too slaty for mining:

Western Maryland Railway Exposure—No. 363 on Map II.

On the east side of North Branch of Potomac River, 0.3 mile northeast of Harrison; **Upper Kittanning Coal**; elevation, 1690′ B.

			Ft.	In.
Sandstone, massive, **Lower Freeport**			30	0
Slate, black			3	0
Coal, slaty, **Upper Kittanning**			2	0
Slate, black			5	0
Fire clay shale, **(Upper Kittanning? or Hardman?)**, with ferriferous limestone, **(Johnstown)**			13	0
Coal	1′	1″		
Shale, dark	0	4	1	8
Coal	0	3		
Fire clay, **Lower Kittanning**, to grade			3	0

Western Maryland Railway Exposure—No. 364 on Map II.

On the east side of North Branch of Potomac River, 0.2 mile northeast of Harrison; **Upper Kittanning Coal**; elevation, 1700′ B.

			Ft.	In.
Sandstone, massive, cliff, **Lower Freeport**			30	0
Coal, very slaty	2′	0″		
Shale, bony	0	3		
Coal, bony	1	2	3	5
Fire clay shale				

Potomac Valley Coal Company Prospect—No. 365 on Map II.

On the north side of Abram Creek, 0.1 mile northeast of Harrison; **Upper Kittanning Coal**; elevation, 1700′ B.

			Ft.	In.
Sandstone, massive, cliff, **Lower Freeport**			30	0
Slate, black			1	0
Fire clay shale			10	0
Slate, black, bony			2	0
Coal	0′	6″		
Slate, black	0	2		
Coal	1	0		
Slate, black	0	2		
Coal	3	2	5	0
Shale and concealed			5	0
Shale, sandy			5	0
Sandstone, massive, in creek, **East Lynn**				

At **Coal Exposure No. 366 on Map II,** along the mountain road east of North Branch of Potomac River 0.1 mile east of Schell, at elevation 2135′ B., there is a blossom of coal 1 foot thick, as recorded in the Schell Section, page 173.

Upper Kittanning Coal, Union District, Grant County.

In Union District, Grant County, there are occasional exposures of Upper Kittanning Coal but it does not appear from their evidence that the seam is capable of furnishing anything more than a limited amount of local domestic fuel and the few borings which have been made through its horizon confirm such a conclusion. The following is the only exposure in the district where good coal was noted at this horizon:

Herr and Company Exposure—No. 367 on Map IV.

On the east side of Stony River, 2.8 miles west of Bismarck; **Upper Kittanning Coal**; elevation, 2985′ B.

			Ft.	In.
1. Sandstone, shaly				
2. Slate, black			4	0
3. **Coal,** soft	1′	5″		
4. Slate, black	0	2		
5. **Coal,** soft	1	4	2	11
6. Bone and shale, to Stony River			2	0

A sample (No. 488R) was collected from Nos. 3 and 5 of section, the composition of which is published under **Mine No. 367** in the Table of Coal Analyses at the end of this Chapter.

The **Fairfax and Landstreet Prospect (No. 368 on Map IV),** on the east side of North Branch of Potomac River 0.6 mile northeast of Wallman, at elevation 2305′ B., appears to be at the Upper Kittanning horizon but it had fallen shut so that no section could be secured, there being a little coal visible on the old dump.

The **J. W. Brock Prospect (No. 369 on Map IV),** on the south side of North Branch of Potomac River 0.5 mile southwest of Steyer, at elevation 2345′ B., had fallen shut, no report about the thickness of the coal being obtained.

Quantity of Upper Kittanning Coal Available.

The following table, compiled by Tucker from a planimetric measurement of the outcrop on Map II for the region limited by Figure 26, shows the probable amount of minable Upper Kittanning Coal in Mineral County:

Probable Amount of Upper Kittanning Coal.

Districts.	Thickness of Coal Assumed. Feet.	Square Miles.	Acres.	Cubic Feet of Coal.	Short Tons of Coal.
Mineral County:					
Piedmont	2	2.75	1,760.0	153,331,200	6,133,248
Elk	2	1.05	672.0	58,544,640	2,341,786
Totals		3.80	2,432.0	211,875,840	8,475,034

LOWER KITTANNING COAL.

The Lower Kittanning Coal, previously described in Chapter VIII, pages 245-6, appears to be of minable thickness and purity in a considerable portion of Piedmont District and in the northern third of Elk District, Mineral County, but in the southern part of Elk District and in Grant County there is no ground for belief that it can furnish more than a very limited amount of local fuel. In the region first named it is usually 2 to 3 feet in thickness with a central slate parting but otherwise clean. This coal has generally been known through the valley as the Clarion, in harmony with the belief that the Split-six Coal was the Lower Kittanning instead of the Upper Freeport which latter it proves to be. The Clarion Coal, however, appears to be represented only by a thin, lenticular, and wholly worthless streak coming a few feet above the Homewood Sandstone and the coal known as the Clarion appears without much doubt to be the Lower Kittanning.

Figure 27 indicates that portion of Mineral County in which the Lower Kittanning Coal is considered to have minable value and on Map II its outcrop is delineated for the same area, but there are doubtless various points within this territory where the coal is not of much value so that local sections should be consulted for more particular data.

Lower Kittanning Coal, Piedmont District, Mineral County.

In Piedmont District the Lower Kittanning Coal has been prospected at only a few points, but just across the Potomac in Allegany County, Maryland, several openings have been made and it is being commercially mined. The following is a prospect on the West Virginia side:

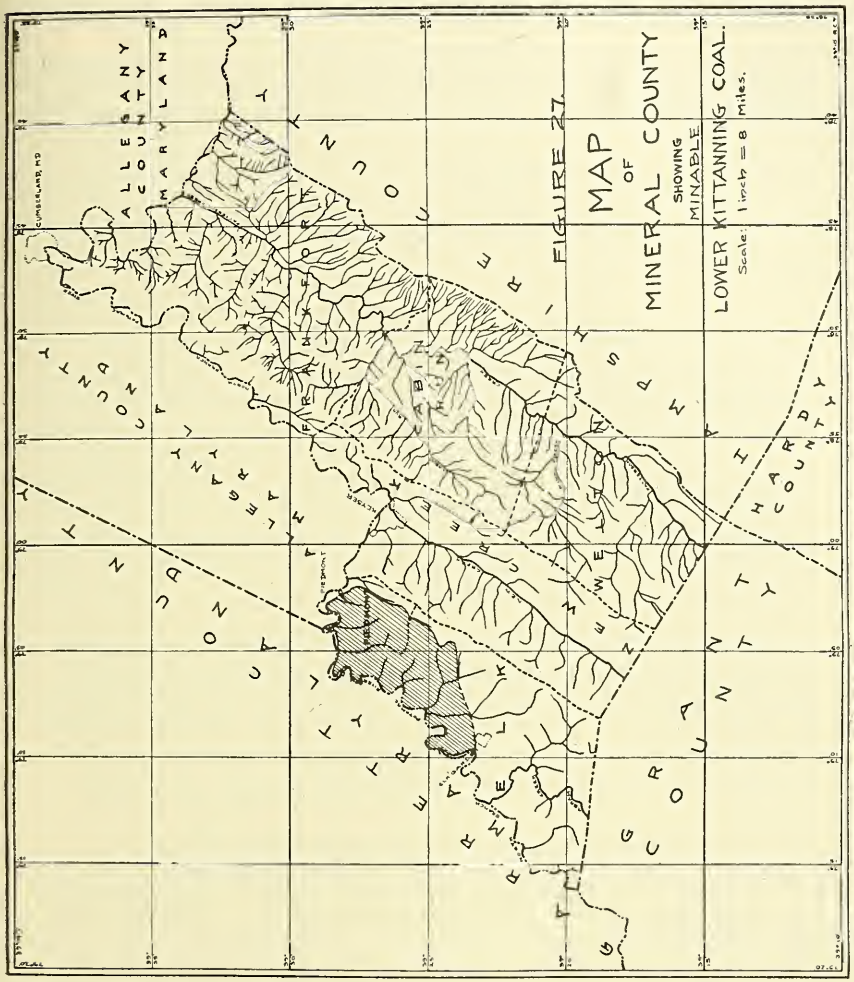


FIGURE 27.
MAP
OF
MINERAL COUNTY
SHOWING
MINABLE
LOWER KITTANNING COAL.
Scale: 1 inch = 8 miles.
ALLEGANY COUNTY MARYLAND
GARRETT COUNTY
HARDY COUNTY
GRANT COUNTY
JEFFERSON
PATTERSON CREEK
KEYSER
CUMBERLAND, MD

Hoffa-Martin Coal Company Prospect—No. 370 on Map II.

On the east side of Slaughterhouse Run of North Branch of Potomac River, 1 mile southeast of Piedmont; **Lower Kittanning Coal;** elevation, 1355′ B.

	Ft.	In.
Sandstone, massive, **East Lynn**	20	0
Coal, reported by Mr. Martin	3	1

The following is a small tipple mine on the Maryland side of the river:

Coal Mine—No. 371 on Map II.

Allegany County, Maryland; on the north side of North Branch of Potomac River, 0.5 mile east of Piedmont; **Lower Kittanning Coal;** elevation, 1140′ B.

			Ft.	In.
Sandstone, massive, cliff				
Coal	1′	7″		
Slate, black	0	1		
Coal	1	1	2	9
Fire clay, flinty, **Lower Kittanning**				

Coal Prospect No. 372 on Map II, located in Allegany County, Maryland, on the north side of North Branch of Potomac River 0.4 mile northeast of Piedmont, at elevation 1076′ B., measured 3′ 3″, with a central parting, as detailed in the Westernport Section, page 154. The following is another exposure in the hill east of Westernport:

Coal Exposure—No. 372A on Map II.

Allegany County, Maryland; on the north side of North Branch of Potomac River, 0.3 mile northeast of Piedmont; **Lower Kittanning Coal;** elevation, 1055′ B.

			Ft.	In.
Sandstone, massive, coarse, **East Lynn**			2ɔ	0
Shale, dark, lenticular, 2′ to			1	0
Coal, soft	1′	8″		
Slate, black	0	2		
Coal, hard	1	2	3	0
Fire clay shale, pavement				

The following mine has recently been opened by the West Virginia Pulp and Paper Company to supply fuel for its mills at Luke and elsewhere, being in active operation when examined:

West Virginia Pulp & Paper Company (No. 2 Devon) Mine —No. 373 on Map II.

Allegany County, Maryland; on the north side of North Branch of Potomac River, at northeast edge of Luke; **Lower Kittanning Coal**; elevation, 977′ B.

			Ft.	In.
1. Sandstone, massive				
2. Draw slate, 0″ to			0	6
3. **Coal**, soft	1′	5″		
4. Slate, dark	0	1		
5. **Coal**, soft	1	1	2	7
6. Shale, pavement				

A sample (No. 531R) was collected from Nos. 3 and 5 of section in Main Heading, the composition of which is published under **Mine No. 373** in the Table of Coal Analyses at the end of this Chapter. From the above mine northeastward toward Westernport several openings have been made in this coal along the river front on the Maryland side but the others have all been abandoned. The following prospect is west of Luke at the public highway grade only a few feet above drainage, there being one inch of slate reported in the middle of the coal:

Coal Prospect—No. 374 on Map II.

Allegany County, Maryland; on the north side of North Branch of Potomac River, 0.3 mile east of Bloomington; **Lower Kittanning Coal**; elevation, 975′ B.

	Ft.	In.
Sandstone, massive, cliff, **East Lynn**	30	0
Coal, partly concealed by water, reported	2	6

On the West Virginia side of the river the blossom of the coal is visible at elevation 1040′ B., near the end of the highway bridge which connects Luke with Piedmont, as recorded in the Piedmont Section, page 157. Farther up the river the following section was secured:

Western Maryland Railway Exposure—No. 375 on Map II.

On the south side of North Branch of Potomac River, at the end of the Western Maryland Railway Y, 0.2 mile southeast of Franklin; **Lower Kittanning Coal**; elevation, 965′ B.

			Ft.	In.
Sandstone, massive, **East Lynn**			15	0
Coal	1′	8½″		
Slate, dark	0	1½		
Coal	1	2	3	0
Fire clay shale, to grade			4	0

The **Baltimore and Ohio Railroad Company Prospect (No. 376 on Map II)**, in Garrett County, Maryland, on the south side of Savage River 2.1 miles northwest of Bloomington, at elevation 1285′ B., had fallen shut, no report on its thickness being obtained.

The **Baltimore and Ohio Railroad Company Exposure (No. 377 on Map II)**, in Garrett County, Maryland, at the old Everette Tunnel which is now an open cut, on the south side of Savage River 2.3 miles northwest of Bloomington, at elevation 1310′ B., had an estimated thickness of 2½ feet, with a central parting, as detailed in the Bond Section, page 161. Owing to its situation in the face of a vertical cut an accurate measurement could not be made.

Lower Kittanning Coal, Elk District, Mineral County.

In Elk District the Lower Kittanning Coal has not been mined for railroad shipment but has been opened at a few points for local fuel. The seven following prospects and exposures are located along the Potomac frontage, one of them being on the Maryland side of the river:

Western Maryland Railway Prospect—No. 378 on Map II.

On the east side of North Branch of Potomac River, 0.3 mile southwest of Warnocks; **Lower Kittanning Coal**; elevation, 1110′ B.

		Ft.	In.
Sandstone, massive, pebbly, **East Lynn**		20	0
Coal	1′ 8″		
Slate, dark	0 1		
Coal	0 7	2	4
Slate, pavement			

Western Maryland Railway Exposure—No. 379 on Map II.

On the east side of North Branch of Potomac River, 0.6 mile northeast of Chaffee; **Lower Kittanning Coal**; elevation, 1450′ B.

		Ft.	In.
Sandstone, massive, cliff, **Lower Freeport**		25	0
Shale and concealed		10	0
Sandstone, massive, cliff, **East Lynn**		30	0
Slate, gray		0	2
Coal, soft	2′ 2″		
Slate, gray	0 2		
Coal	0 6	2	10
Fire clay shale		3	0
Limestone, ferriferous, **Vanport**		1	0
Shale, sandy, to grade		5	0

Western Maryland Railway Exposure—No. 380 on Map II.

On the east side of North Branch of Potomac River, 0.3 mile northeast of Chaffee; **Lower Kittanning Coal**; elevation, 1480′ B.

	Ft.	In.
Sandstone, cliff, **Lower Freeport**	50	0
Shale, 0′ to	2	0
Sandstone, cliff, **East Lynn**	30	0
Coal, 0′ 2″ to	0	6
Shale, sandy, with ferriferous limestone, **Vanport**, to grade	10	0

Western Maryland Railway Exposure—No. 381 on Map II.

On the east side of North Branch of Potomac River, 0.1 mile northeast of Chaffee; **Lower Kittanning Coal**; elevation, 1485′ B.

	Ft.	In.
Sandstone, shaly		
Coal, slaty	1	6
Shale, sandy, with ferriferous limestone, **Vanport**, to grade	5	0

Western Maryland Railway Exposure—No. 382 on Map II.

On the east side of North Branch of Potomac River, 0.6 mile northwest of Elk Garden; **Lower Kittanning Coal**; elevation, 1530′ B.

	Ft.	In.
Shale, with ferriferous limestone, **Johnstown (?)**	20	0
Sandstone, massive, **East Lynn**	30	0
Slate, black, at grade, **Lower Kittanning Coal?**	2	0
Sandstone, massive, **Homewood?**, to river	20	0

The elevation at the above exposure indicates some doubt as to whether this black slate exposure is actually at the Lower Kittanning horizon or at some higher level, but the stratigraphic association strongly favors the indicated classification.

Hamill Coal Company Exposure—No. 383 on Map II.

Garrett County, Maryland; on the north side of North Branch of Potomac River, 0.7 mile north of Blaine; **Lower Kittanning Coal**; elevation, 1595′ B.

	Ft.	In.
Sandstone, massive, great cliff, **East Lynn**	50	0
Coal	0	10
Fire clay, **Lower Kittanning**, visible	5	0
Concealed, to Potomac River	25	0

Western Maryland Railway Exposure—No. 384 on Map II.

On the east side of North Branch of Potomac River, 0.3 mile northeast of Harrison; **Lower Kittanning Coal**; elevation, 1670′ B.

			Ft.	In.
Fire clay, with ferriferous limestone, **Johnstown Limestone**			13	0
Coal	1′	1″		
Shale, dark	0	4		
Coal	0	3	1	8
Fire clay, **Lower Kittanning**, to grade			3	0

The following farm mine is located well up toward the top of the Allegheny Front, coal being hauled from it to Keyser and the New Creek Valley where no local fuel is available:

Pulliam and Ravenscroft Farm Mine—No. 385 on Map II.

On the west slope of the Allegheny Mountain, 1.1 miles east of Hartmansville; **Lower Kittanning Coal**; elevation, 2800′ B.

			Ft.	In.
1. Shale, dark				
2. **Coal**, soft	1′	7″		
3. Slate, dark	0	1		
4. **Coal**, soft	0	11	2	7
5. Fire clay shale, pavement				

A sample (No. 577R) was collected from Nos. 2 and 4 of section, the composition of which is published under **Mine No. 385** in the Table of Coal Analyses at the end of this Chapter.

The **Gleason Coal and Coke Company Prospect (No. 386 on Map II)**, on the south side of North Branch of Potomac River 0.2 mile east of Gleason, at elevation 1810′ B., had fallen shut, the coal being reported as 1′ 6″ thick.

On the Maryland side of the river opposite Hubbard the blossom of the coal is visible at elevation 2070′ B., as indicated in the Hubbard Section, page 172.

At **Coal Exposure No. 387 on Map II**, in the mountain road east of North Branch of Potomac River 0.2 mile east of Schell, there is 1 foot of coal visible at a blossom, as recorded in the Schell Section, page 173.

Lower Kittanning Coal, Union District, Grant County.

In Union District the evidence does not indicate that there is any minable extent of Lower Kittanning Coal, the

following being the only prospect noted, and there being little coal recorded in such borings as have passed through this horizon:

Fairfax and Landstreet Prospect—No. 388 on Map IV.

On the east side of North Branch of Potomac River, opposite Wallman; **Lower Kittanning Coal**; elevation, 2245′ B.

			Ft.	In.
Sandstone, massive				
Coal	0′	8″		
Shale, gray	1	3		
Coal	1	4	3	3
Shale, concealed, and shale			10	0
Coal, Clarion			0	10
Shale, sandy			5	0
Sandstone, **Homewood**				

At the **Western Maryland Railway Exposure (No. 389 on Map IV),** in Garrett County, Maryland, on the west side of North Branch of Potomac River 0.3 mile southwest of Wallman, at elevation 2245′ B., only a thin blossom is visible.

Quantity of Lower Kittanning Coal Available.

The following table, compiled by Tucker from a planimetric measurement of the outcrop on Map II, for the region indicated on Figure 27 as having minable coal, shows the probable amount of Lower Kittanning Coal in that portion of Mineral County which contains it:

Probable Amount of Lower Kittanning Coal.

Districts.	Thickness of Coal Assumed. Feet.	Square Miles.	Acres.	Cubic Feet of Coal.	Short Tons of Coal.
Mineral County:					
Piedmont	2½	7.15	4,576.0	498,326,400	19,933,056
Elk	2	14.85	9,504.0	827,988,480	33,119,539
Totals		22.00	14,080.0	1,326,314,880	53,052,595

SUMMARY OF AVAILABLE COAL.

For convenience of reference all the mines, prospects and exposures described in this Report have been given serial numbers which are printed in blue on Maps II and IV, depending on whether they are in Mineral or Grant County, there being in each case a conventional mine symbol indicating the exact location. Disregarding those which apply to coals having no commercial significance, the following table, compiled by Tucker, gives a list of the numbers which refer to the 13 commercial seams described in the present Chapter, as well as a summary of the total amount of coal that each seam is estimated to contain.

This table represents the amount of coal believed to have been available in the two counties before mining began. Deducting 95 per cent. (1,774,635 short tons) of the total Sewickley Coal as having already been mined or lost, in accordance with the estimate on page 513; 50 per cent. (2,542,510 short tons) of the total Redstone as probably having been lost through lack of support, according to the estimate on page 516; 99 per cent. (41,410,464 short tons) of the total Pittsburgh as having been mined or lost, according to the estimate on page 527; and 10 per cent. (12,088,074 short tons) of the total Elk Lick ("Barton," "Four-foot") as having been mined or lost, according to the estimate on page 555, there remains a grand total of 1,721,032,538 short tons of commercial coal in the two counties. Allowing for a recovery of 80 per cent., the total coal that may now be eventually mined is 1,376,826,030 short tons (2,000 pounds). In computing tonnage a short ton is assumed as representing 25 cubic feet of coal:

Summary of Available Coal by Counties and Districts.

Coal Bed.	Mines and Prospects Listed on Maps II and IV and Described in Chapter XVII.	Mineral County.			Grant County			Total Both Counties.
		Piedmont District.	Elk District.	Total.	Union District.	Milroy District.	Total.	
Sewickley ("Tyson")	1-3	1,115,136	752,717	1,867,853				1,867,853
Redstone	4-5	903,260	4,181,760	5,085,020				5,085,020
Pittsburgh ("Big Vein")	6-35	5,754,101	35,461,325	41,215,426	613,325		613,325	41,828,751
Little Pittsburgh	39-41				334,541		334,541	334,541
Little Clarksburg ("Franklin," "Dirty Nine-foot")	44-58	3,902,976	24,756,019	28,658,995				28,658,995
Elk Lick ("Barton," "Four-foot")	72-131	9,144,115	60,217,344	69,361,459	51,519,283		51,519,283	120,880,742
Harlem	144-162		44,661,197	44,661,197	45,581,184		45,581,184	90,242,381
Upper Bakerstown	163-180	17,897,933	73,598,976	91,496,909				91,496,909
Bakerstown ("Thomas")	181-246	15,751,296	130,972,723	146,724,019	269,974,426		269,974,426	416,698,445
Mahoning ("Six-foot")	252-293	27,655,373	76,804,992	104,460,365				104,460,365
Upper Freeport ("Split-six," "Davis")	294-346	14,496,768	200,278,426	214,775,194	600,891,034	100,362	600,991,396	815,766,590
Upper Kittanning	353-369	6,133,248	2,341,786	8,475,034				8,475,034
Lower Kittanning	370-389	19,933,056	33,119,539	53,052,595				53,052,595
Total		122,687,262	687,146,804	809,834,066	968,913,793	100,362	969,014,155	1,778,848,221

After this Volume had gone to press the following letter, bearing date of August 6, 1923, and relative to the original and remaining amounts of Pittsburgh ("Big Vein") and Sewickley ("Tyson") Coals in Mineral County, was received from Mr. S. B. Jeffries, Chief Engineer, Davis Coal and Coke Company, Thomas, West Virginia, in response to a previous inquiry:

"I am very sorry I have been unable to reply to your letter of July 2 before this time, but on account of a rush of outside work we have been kept very busy.

"The Big Vein and Tyson Coal seams were nearly all worked out when I came with this company, and I have been unable to find any figures showing tonnage shipped, however, I did find some old maps which showed the original areas of these seams and the locations you mentioned and I am listing below some figures which may help you:

Location.	Original Area of Big Vein. Acres.	Worked out. Acres.	Remaining. Acres.
Hampshire Hill west of Montgomery Run	160	157	3
Windom (Now Virginia Big Vein Coal Company)	114	112	2
Elk Garden (Dean Coal Company)	315	310	5
Wabash	80	79	1

Location.	Original Area of Tyson. Acres.	Worked out. Acres.	Remaining. Acres.
Hampshire Hill West of Montgomery Run	55	50	5
Windom	4	0	4
Elk Garden	40	38	2
Wabash	0	0	0

"The above figures on original areas were taken from old maps where in some places the outcrops were not completely shown, and had to be approximated. The remaining areas were arrived at by investigations in the field and estimated by location of falls and crop lines, so this naturally is only a rough estimate. Upon opening we often encounter old works which did not throw a cave to the surface, and in other cases we are able to cross old works and recover some coal left inside the outside fall-line.

"The amount of recoverable Big Vein also depends on market conditions, as in times of poor demand it is hard to dispose of stained coal.

"The Tyson seam near the Junction and at Elk Garden was inclined to be rolly and in places is cut out by sandrock, so some of the original area did not contain workable coal. Also at each location considerable areas of this seam are unworkable on account of shallow cover resulting in soft and stained coal.

"In Mineral County there are also two other small areas of Pittsburgh that you do not mention. The old Atlantic Mine on Deep Run now owned by the Deep Run Big Vein Coal Company of Piedmont. I think this hill originally contained about 40 acres of Pittsburgh Coal, and a small area of Tyson Coal, both of which are now practically worked out. Mr. C. H. Lantz, of Piedmont, President of this company, could give you some information on this area. Then southeast of Shaw there was a small area of Big Vein, probably 20 acres, which in 1918 was partially stripped by Brydon Brothers, and Mr. Howard Brydon of Bloomington, Md., could probably give you some data on this piece. I hope the above information may be of some use to you, and am only sorry I can not give it more accurately.

"Very truly yours,

"S. B. JEFFRIES, Chief Engineer."

The figures given by Mr. Jeffries do not include several small areas of Pittsburgh Coal in Mineral County that are not definitely assignable to the localities mentioned in his letter and at Elk Garden they evidently cover only the portion of the acreage that is controlled by the Dean Coal Company, there being another considerable tract operated by the Smith Big Vein Coal Company, as well as some smaller lots. There are also a few acres of Pittsburgh territory in the vicinity of Fairfax Knob, Grant County, so that there should be added a considerable amount to the 729 acres mentioned in Mr. Jeffries' letter. It is also probable that the private surveys made of the coal at this early period used a much restricted outcrop line in order to discard poorly covered coal. Even with due allowances for the reasons mentioned there is apparent a considerable discrepancy between the figures of Mr. Jeffries and the planimetric measurements made by Mr. Tucker on Maps II and IV, as published on page 527, and it is possible that the latter are somewhat too large.

In the Sewickley Coal the figures of Mr. Jeffries give a total of only 99 acres while the computations of Mr. Tucker, as published on page 513, total 214 acres. In this case also it is probable that the different interpretation of outcrop is mainly responsible for the difference, since any coal which crops only near the tops of the ridges is difficult to measure with accuracy.

On the unmined acreage for the two coals the figures given on previous pages of this Report do not differ materi-

ally from those of Mr. Jeffries, and are primarily based on the data contained in his letter.

MINABLE COALS BY MAGISTERIAL DISTRICTS.

The minable coals of the two counties, as so classified in this Report, have been described by magisterial districts on previous pages of this Chapter. In the Index at the end of the Report, under the heading "Minable Coals by Magisterial Districts," will be found a list of page references making this information available without further discussion.

TABLE OF COAL ANALYSES.

The following table, compiled by Tucker, containing the proximate and ultimate analyses of 74 mines and prospects, together with calorific determinations, fuel ratios, and carbon ratios, is the exclusive work of members of the Survey Staff. All the samples were taken by the writer in the field, those from commercial mines being cut on a large cloth, mixed, pulverized, and quartered until the coal remaining filled a small tin can, in which it was hermetically sealed. Samples from prospects or remote openings where standard equipment could not be taken were collected in small bags with as much care as was possible.

The chemical work was done by B. B. Kaplan, Chemist, in the Laboratory of the Survey at Morgantown.

In addition to the analyses given in the table, a few others are published on preceding pages, along with the descriptions of the mines from which the samples were taken, the same being furnished by mine owners or other interested parties, or taken from other official reports. These are doubtless quite as accurate as those to be found in the Survey Table, but it is thought best to present them separately.

In the Survey Table below, the numbers on the left-hand margin correspond to the numbers given with the descriptions of the mines and with the symbols on Maps II and IV. All the samples were cut from the mining sections of the seams, unless otherwise described, the usual method being to discard from the samples such slates or other impurities as would be rejected in ordinary commercial shipment:

Table of Coal Analyses.

(Under "Condition of Sample," "A. D." = air-dried; "A. R." = as received; "M. F." = moisture-free.)

No. on Map II or IV.	Mine.	Coal Bed.	Condition of Sample.	Proximate.				Common to both.		Ultimate.				Calorimeter B. T. U. for 1 Lb. of Coal.	Calculated B. T. U. for 1 Lb. of Coal.	Fuel Ratio (Carbon Divided by Oxygen + Ash.)	Carbon Ratio (Fixed Carbon Divided by Sum of F. C. and V. M.)
				Moisture.	Volatile Matter.	Fixed Carbon.	Phosphorus.	Ash.	Sulphur.	Carbon.	Hydrogen.	Oxygen.	Nitrogen.				
2	Dean Coal Co. (No. 4 Tyson)	Sewickley	A. D.	4.35	22.35	61.60	0.0200	11.70	1.18	67.82	3.92	14.22	1.16	10,708	10,692	2.62	73.38
2	Dean Coal Co. (No. 4 Tyson)	Sewickley	A. R.	10.22	20.98	57.82	0.0187	10.98	1.10	63.69	4.35	18.79	1.09	10,053	10,038	2.14	73.38
11	Virginia Big Vein Coal Co. (South)	Pittsburgh	A. R.	0.53	17.87	76.15	0.0158	5.45	1.21	83.35	4.64	3.57	1.78	14,780	14,844	9.24	80.99
12	H. P. Brydon & Bro., Inc.	Pittsburgh	M. F.	0.00	25.60	66.05	0.0367	8.35	0.84	74.46	3.71	10.99	1.65	12,400	12,372	3.85	72.07
12	H. P. Brydon & Bro., Inc.	Pittsburgh	A. R.	4.75	24.36	62.94	0.035	7.95	0.79	70.87	4.06	14.76	1.57	11,816	11,794	3.12	72.10
16	Deep Run Big Vein Coal Co.	Pittsburgh	A. R.	0.80	19.37	74.03	0.01	5.80	0.93	83.14	4.56	3.85	1.72	14,394	14,500	8.62	79.26
17	Thomas Dixon	Pittsburgh	A. R.	1.49	20.37	73.03	0.0061	5.11	0.91	81.93	4.20	6.16	1.69	14,300	14,171	7.27	78.19
24	Smith Big Vein Coal Co. (No. 1)	Pittsburgh	A. D.	0.40	17.60	75.10	0.058	6.90	0.80	82.32	4.50	3.81	1.67	14,428	14,589	7.69	81.01
24	Smith Big Vein Coal Co. (No. 1)	Pittsburgh	A. R.	2.99	17.14	73.15	0.056	6.72	0.78	80.18	4.67	6.03	1.62	14,053	14,209	6.29	81.02
	Average	Pittsburgh	A. R.	2.11	19.82	71.86	0.0246	6.21	0.92	79.89	4.43	6.87	1.68	13,869	13,904	6.11	78.38
41	Davis Coal & Coke Co. No. 61	Little Pittsburgh	A. D.	0.86	25.94	67.85	0.099	5.35	0.95	82.82	5.08	4.48	1.32	14,890	14,790	8.43	72.34
41	Davis Coal & Coke Co. No. 61	Little Pittsburgh	A. R.	0.86	25.94	67.85	0.099	5.35	0.95	82.82	5.08	4.48	1.32	14,890	14,790	8.43	72.34
47	Nalley Tract	Little Clarksburg	A. R.	4.95	24.35	59.66	0.0145	11.04	0.53	65.13	3.83	18.40	1.07	10,754	10,831	2.21	71.02
53	John Durham	Little Clarksburg	A. R.	0.36	18.44	70.27	0.0093	10.93	2.33	78.38	4.46	2.31	1.59	13,870	14,016	5.92	79.21
	Average	Little Clarksburg	A. R.	2.66	21.39	64.97	0.0119	10.98	1.43	71.76	4.15	10.35	1.33	12,312	12,424	3.36	75.23
74	Silver Coal Co. (No. 2)	Elk Lick	A. D.	0.75	14.58	76.47	0.00508	8.20	1.12	80.79	4.28	4.19	1.42	14,250	14,207	6.52	83.99
74	Silver Coal Co. (No. 2)	Elk Lick	A. R.	3.66	14.15	74.23	0.00493	7.96	1.09	78.43	4.48	6.66	1.38	13,833	13,789	5.36	83.99
75	Silver Coal Co. (No. 3)	Elk Lick	A. D.	0.80	14.50	76.30	0.0069	8.40	1.94	80.91	4.34	2.99	1.42	14,423	14,397	7.10	84.03
75	Silver Coal Co. (No. 3)	Elk Lick	A. R.	1.98	14.33	75.39	0.0068	8.30	1.92	79.95	4.42	4.01	1.40	14,251	14,226	6.49	84.03
78	Masteller Coal Co. (No. 4)	Elk Lick	A. D.	0.41	16.04	73.67	0.0052	9.88	2.10	79.29	4.12	3.37	1.24	13,946	13,986	5.98	82.12
78	Masteller Coal Co. (No. 4)	Elk Lick	A. R.	2.75	15.66	71.94	0.0051	9.65	2.05	77.43	4.28	5.38	1.21	13,617	13,657	5.15	82.12
80	Masteller Coal Co. (No. 5)	Elk Lick	A. D.	0.70	15.80	73.18	0.0044	10.32	2.81	78.74	4.02	2.76	1.35	13,850	13,934	6.02	82.24
80	Masteller Coal Co. (No. 5)	Elk Lick	A. R.	2.38	15.53	71.95	0.0043	10.14	2.76	77.41	4.14	4.23	1.32	13,616	13,698	5.39	82.25
86	Kalbaugh Coal Co.	Elk Lick	A. D.	0.85	15.50	73.05	0.0161	10.60	2.31	78.39	4.12	3.16	1.42	13,675	13,888	5.70	82.50
86	Kalbaugh Coal Co.	Elk Lick	A. R.	1.91	15.33	72.28	0.0159	10.48	2.29	77.45	4.19	4.19	1.40	13,529	13,729	5.28	82.50
87	H. P. Brydon & Bro., Inc. (Shaw)	Elk Lick	A. D.	0.34	15.86	74.25	0.0456	9.55	0.90	80.69	4.26	3.07	1.53	14,001	14,267	6.39	82.40
87	H. P. Brydon & Bro., Inc. (Shaw)	Elk Lick	A. R.	1.91	15.41	73.30	0.0449	9.38	0.89	79.41	4.38	4.43	1.51	13,780	14,040	5.75	82.63

Table of Coal Analyses, (Continued).

(Under "Condition of Sample," "A. D." = air-dried; "A. R." = as received; "M. F." = moisture-free.)

No. on Map II or IV.	Mine.	Coal Bed.	Condition of Sample.	Proximate.				Common to both.		Ultimate.				Calorimeter B. T. U. for 1 Lb. of Coal.	Calculated B. T. U. for 1 Lb. of Coal.	Fuel Ratio (Carbon Divided by Oxygen + Ash).	Carbon Ratio (Fixed Carbon Divided by Sum of F. C. and V. M.).
				Moisture.	Volatile Matter.	Fixed Carbon.	Phosphorus.	Ash.	Sulphur.	Carbon.	Hydrogen.	Oxygen.	Nitrogen.				
91	Deep Run B. V. Coal Co. (Grant 1)	Elk Lick	A. D.	0.70	16.20	72.20	0.1001	10.90	3.18	77.94	4.13	2.45	1.40	13,725	13,919	5.84	81.67
91	Deep Run B. V. Coal Co. (Grant 1)	Elk Lick	A. R.	2.27	15.94	71.06	0.0984	10.73	3.13	76.71	4.25	3.80	1.38	13,508	13,699	5.28	81.68
92	Deep Run B. V. Coal Co. (Grant 3)	Elk Lick	A. D.	0.55	16.55	73.02	0.0292	9.88	3.76	78.56	4.25	2.13	1.42	13,956	13,946	6.54	81.52
92	Deep Run B. V. Coal Co. (Grant 3)	Elk Lick	A. R.	1.94	16.32	72.00	0.0288	9.74	3.70	77.46	4.33	3.37	1.40	13,760	13,750	5.91	81.52
93	Jaffy Coal M'ng Co. (No. 4 Swayne)	Elk Lick	A. D.	0.44	17.11	68.29	0.0420	14.16	3.78	75.51	4.08	1.11	1.36	13,468	13,653	4.94	79.96
93	Jaffy Coal M'ng Co. (No. 4 Swayne)	Elk Lick	A. R.	1.28	16.97	67.71	0.0416	14.04	3.75	74.87	4.14	1.85	1.35	13,365	13,538	4.71	79.96
96	Jack Jones	Elk Lick	A. R.	0.20	15.40	73.80	0.0054	10.60	3.07	79.05	4.14	1.62	1.52	14,044	14,124	6.47	82.74
97	James R. Green Heirs	Elk Lick	A. R.	1.80	17.75	73.60	0.013	6.85	1.10	80.13	4.29	6.39	1.24	13,915	13,920	6.05	80.57
101	Mapleville Coal Co.	Elk Lick	A. D.	0.40	16.10	72.12	0.0052	11.38	3.90	77.10	4.20	2.13	1.29	13,892	13,892	5.71	81.75
101	Mapleville Coal Co.	Elk Lick	A. R.	1.89	15.85	71.05	0.0051	11.21	3.84	75.94	4.39	3.35	1.27	13,689	13,689	5.22	81.76
102	Miller & Lemon	Elk Lick	A. D.	0.55	15.00	68.19	0.0422	16.26	5.40	70.18	4.01	2.88	1.27	12,900	12,825	3.67	81.97
102	Miller & Lemon	Elk Lick	A. R.	1.68	14.83	67.42	0.0417	16.07	5.34	69.39	4.09	3.85	1.26	12,754	12,680	3.48	81.97
103	Pritts Bros. Coal Co.	Elk Lick	A. D.	0.41	16.24	69.65	0.036	13.70	4.80	74.15	3.97	2.07	1.31	13,340	13,268	4.70	81.09
103	Pritts Bros. Coal Co.	Elk Lick	A. R.	1.45	16.07	68.92	0.0355	13.56	4.75	73.37	4.03	2.99	1.30	13,201	13,130	4.43	81.09
104	Clise Bros. Coal Co.	Elk Lick	A. D.	0.75	15.35	73.90	0.0156	10.00	3.04	77.75	4.44	3.23	1.54	13,957	14,004	5.88	82.80
104	Clise Bros. Coal Co.	Elk Lick	A. R.	2.85	15.03	72.33	0.0153	9.79	2.98	76.10	4.50	5.12	1.51	13,663	13,705	5.10	82.80
105	Low Volatile Coal Co.	Elk Lick	A. D.	0.62	15.31	71.97	0.0144	12.10	2.86	76.60	4.18	2.98	1.28	12,756	13,704	5.08	82.46
105	Low Volatile Coal Co.	Elk Lick	A. R.	1.46	15.18	71.36	0.0143	12.00	2.85	75.96	4.23	3.69	1.27	13,589	13,640	4.84	82.46
106	Vanderber Coal & Coke Co.	Elk Lick	A. D.	0.62	16.23	71.94	0.0108	11.21	2.99	78.29	4.33	1.79	1.39	14,075	14,137	6.02	81.59
106	Vanderber Coal & Coke Co.	Elk Lick	A. R.	1.02	16.16	71.63	0.0107	11.19	2.98	77.93	4.36	2.16	1.38	14,010	14,071	5.84	81.59
108	Mont Alto Coal Co.	Elk Lick	A. R.	0.60	16.90	75.50	0.0044	7.00	2.20	80.61	4.43	4.30	1.46	14,308	14,322	7.13	81.71
109	Bakertown Coal Co.	Elk Lick	A. D.	0.47	15.23	69.10	0.0159	15.20	3.88	73.00	4.11	2.57	1.24	13,200	13,207	4.11	81.94
109	Bakertown Coal Co.	Elk Lick	A. R.	2.08	14.98	67.99	0.0156	14.95	3.82	71.82	4.22	3.97	1.22	12,986	12,993	3.80	81.95
113	Love Coal Co.	Elk Lick	A. D.	0.60	15.20	68.00	0.0092	16.20	5.35	71.07	3.98	2.13	1.27	12,868	12,937	3.88	81.73
113	Love Coal Co.	Elk Lick	A. R.	0.84	15.16	67.84	0.00917	16.16	5.34	70.96	4.00	2.27	1.27	12,836	12,906	3.85	81.73
122	James Shillingburg	Elk Lick	A. R.	0.27	15.18	71.02	0.0228	13.53	4.45	75.00	4.12	1.65	1.25	13,700	13,601	4.94	82.39
	Average	Elk Lick	A. D.	0.59	15.69	72.08	0.02376	11.64	3.18	77.00	4.17	2.65	1.36	13,722	13,775	5.39	82.12
	Average	Elk Lick	A. R.	1.72	15.63	71.54	0.02113	11.11	3.06	76.45	4.26	3.77	1.35	13,617	13,662	5.14	82.07

Table of Coal Analyses, (Continued).

(Under "Condition of Sample," "A. D." = air-dried; "A. R." = as received; "M. F." = moisture-free.)

No. on Map II or IV.	Mine.	Coal Bed.	Condition of Sample.	Proximate.				Common to both.		Ultimate.				Calorimeter B. T. U. for 1 Lb. of Coal.	Calculated B. T. U. for 1 Lb. of Coal.	Fuel Ratio (Carbon Divided by Oxygen + Ash.)	Carbon Ratio (Fixed Carbon Divided by Sum of F. C. and V. M.)
				Moisture.	Volatile Matter.	Fixed Carbon.	Phosphorus.	Ash.	Sulphur.	Carbon.	Hydrogen.	Oxygen.	Nitrogen.				
150	Jack Jones	Harlem	A. R.	0.25	17.10	72.10	0.0100	10.55	2.31	79.50	4.09	2.39	1.16	13,985	14,103	6.14	80.83
195	Jaffy Coal Mining Co.	Bakerstown	A. D.	0.32	15.28	75.90	0.0304	8.50	3.17	80.56	4.12	2.31	1.34	14,276	14,308	7.45	83.24
195	Jaffy Coal Mining Co.	Bakerstown	A. R.	2.13	15.00	74.52	0.0298	8.35	3.11	79.10	4.25	3.87	1.32	14,018	14,049	6.47	83.24
197	Deep Run Big Vein Coal Co.	Bakerstown	A. R.	0.54	14.76	75.38	0.0088	9.32	2.92	79.50	3.99	2.99	1.28	14,002	14,013	6.46	83.63
202	Grafton Mining Co.	Bakerstown	A. D.	0.47	14.23	77.00		8.30	0.53	82.19	4.14	3.38	1.46	14,300	14,253	7.04	84.40
202	Grafton Mining Co.	Bakerstown	A. R.	2.53	13.93	75.41	0.0248	8.13	0.52	80.57	4.28	5.07	1.43	14,001	13,955	6.10	84.41
204	St. Cloud Coal Co. (Ida)	Bakerstown	A. D.	0.28	15.52	70.81	0.0480	13.39	3.37	75.60	4.06	2.42	1.16	13,598	13,546	4.78	82.02
204	St. Cloud Coal Co. (Ida)	Bakerstown	A. R.	2.20	15.22	69.45	0.0470	13.13	3.30	74.14	4.19	4.10	1.14	13,365	13,285	4.30	82.02
205	Grace Coal Co.	Bakerstown	A. D.	0.40	14.60	74.65	0.0464	10.35	0.61	79.71	4.12	3.94	1.27	13,868	13,957	5.58	83.64
205	Grace Coal Co.	Bakerstown	A. R.	2.97	14.22	72.73	0.0452	10.08	0.59	77.65	4.38	6.07	1.23	13,510	13,598	4.81	83.65
206	Brady Coal Corp. (Abrams Creek)	Bakerstown	A. D.	0.36	14.84	78.04	0.0070	6.76	1.00	83.52	4.16	3.40	1.16	14,550	14,624	8.22	84.02
206	Brady Coal Corp. (Abrams Creek)	Bakerstown	A. R.	2.19	14.57	76.61	0.0069	6.63	0.98	81.98	4.28	4.99	1.14	14,282	14,355	7.05	84.08
208	Donley Coal Co.	Bakerstown	A. D.	0.25	14.55	77.52	0.0160	7.68	2.32	82.24	4.13	2.35	1.28	14,372	14,527	8.20	84.20
208	Donley Coal Co.	Bakerstown	A. R.	2.56	14.21	75.73	0.0156	7.50	2.27	80.32	4.29	4.37	1.25	14,035	14,187	6.77	84.20
212	Carroll-Cross Coal Co. (Imperial 2)	Bakerstown	A. D.	0.25	14.30	76.52	0.0180	8.93	0.98	81.57	4.16	3.07	1.29	14,276	14,338	6.80	84.25
212	Carroll-Cross Coal Co. (Imperial 2)	Bakerstown	A. R.	2.29	14.01	74.96	0.0176	8.74	0.96	79.90	4.30	4.84	1.26	13,983	14,044	5.88	84.25
218	N. B. Harvey	Bakerstown	A. R.	0.45	16.55	71.05		11.95	0.90								
219	W. W. Kitzmiller	Bakerstown	A. R.	0.80	15.85	74.85	0.008	8.50	1.41	82.02	4.28	2.42	1.37	14,571	14,545	7.51	82.52
221	W. H. Kitzmiller	Bakerstown	A. R.	1.25	16.75	75.05	0.0184	6.95	0.57	82.06	4.30	4.69	1.43	14,396	14,350	7.05	81.75
224	M. F. Cosner	Bakerstown	A. R.	0.50	16.10	73.65	0.0190	9.75	0.75	80.00	4.22	4.01	1.27	14,017	14,000	5.81	82.06
225	Elmer Kuhn	Bakerstown	A. R.	0.70	16.10	77.00	0.051	6.20	0.70	84.24	4.30	3.10	1.46	14,521	14,798	10.13	82.71
228	Herr & Co.	Bakerstown	A. R.	0.25	16.05	70.12	0.0560	13.58	2.61	75.46	4.12	2.98	1.25	13,559	13,489	4.56	81.37
230	Herr & Co.	Bakerstown	A. R.	0.28	18.12	66.65	0.0112	14.95	3.66	73.58	4.12	2.49	1.20	13,272	13,292	4.22	78.62
235	Wm. Wilson	Bakerstown	A. R.	0.95	16.65	66.03		16.37	0.72								
246	Davis C. & C. Co. (No. 22 Henry)	Bakerstown	A. D.	0.18	23.38	68.77	0.0074	7.67	2.53	80.87	4.56	2.87	1.50	14,495	14,551	7.67	74.63
246	Davis C. & C. Co. (No. 22 Henry)	Bakerstown	A. R.	2.65	22.80	67.07	0.0072	7.48	2.47	78.87	4.72	5.00	1.46	14,136	14,191	6.32	74.63
	Average	Bakerstown	A. D.	0.31	15.84	74.90	0.0216	8.95	1.81	80.78	4.18	2.97	1.31	14,217	14,263	6.78	82.54
	Average	Bakerstown	A. R.	1.48	15.94	72.72	0.0216	*9.86	1.67	79.29	4.27	4.07	1.30	13,978	14,010	5.94	82.02
								†9.28	1.79								

* Figured from Proximate analyses.
† Figured from Ultimate analyses.

Table of Coal Analyses, (Continued).

(Under "Condition of Sample," "A. D." = air-dried; "A. R." = as received; "M. F." = moisture free.)

No. on Map II or IV.	Mine.	Coal Bed.	Condition of Sample.	Proximate.				Common to both.		Ultimate.				Calorimeter B. T. U. for 1 Lb. of Coal.	Calculated B. T. U. for 1 Lb. of Coal.	Fuel Ratio (Carbon Divided by Oxygen + Ash).	Carbon Ratio (Fixed Carbon Divided by Sum of F. C. and V. M.).
				Moisture.	Volatile Matter.	Fixed Carbon.	Phosphorus.	Ash.	Sulphur.	Carbon.	Hydrogen.	Oxygen.	Nitrogen.				
252	Hoffa-Martin Coal Co.	Mahoning	A. R.	1.18	16.42	73.39	0.0147	9.01	0.71	79.52	4.29	5.10	1.37	13,864	13,946	5.64	81.72
255	Twin Mountain Coal Co. (Fahey)	Mahoning	A. D.	0.25	15.60	74.35	0.036	9.80	1.37	80.13	4.17	3.00	1.53	14,198	14,292	6.26	82.66
255	Twin Mountain Coal Co. (Fahey)	Mahoning	A. R.	0.50	15.56	74.16	0.036	9.78	1.37	79.93	4.19	3.21	1.52	14,162	14,256	6.15	82.66
261	Silver Coal Co. (No. 1)	Mahoning	A. D.	0.65	15.00	76.13	0.0206	8.22	1.13	80.39	4.31	4.80	1.15	14,083	14,128	6.17	83.54
261	Silver Coal Co. (No. 1)	Mahoning	A. R.	2.90	14.66	74.41	0.0206	8.03	1.10	78.57	4.46	6.72	1.12	13,808	13,764	5.33	83.54
283	F. M. Reynolds	Mahoning	A. R.	0.55	19.45	64.77	0.0141	15.23	1.18	73.47	4.23	4.84	1.05	13,054	13,066	3.66	76.91
285	Fortney & Piles	Mahoning	A. D.	0.55	15.15	75.70	0.0369	8.60	0.78	81.93	4.14	3.40	1.15	14,230	14,285	6.83	83.32
285	Fortney & Piles	Mahoning	A. R.	3.57	14.69	73.40	0.0358	8.34	0.76	79.44	4.35	5.99	1.12	13,797	13,850	5.54	83.32
287	Eddy Coal Co.	Mahoning	A. D.	0.50	14.00	75.29	0.0523	10.21	1.20	80.41	4.00	3.05	1.13	14,000	14,083	6.06	84.32
287	Eddy Coal Co.	Mahoning	A. R.	2.24	13.75	73.98	0.0514	10.03	1.17	79.00	4.12	4.57	1.11	13,755	13,836	5.41	84.33
289	Gleason Coal & Coke Co. (No. 3)	Mahoning	A. D.	0.47	14.98	74.40	0.130	10.15	0.50	81.13	3.99	2.95	1.28	14,056	14,155	6.19	83.24
289	Gleason Coal & Coke Co. (No. 3)	Mahoning	A. R.	2.52	14.67	72.87	0.127	9.94	0.49	79.47	4.14	4.71	1.25	13,766	13,863	5.42	83.24
	Average	Mahoning	A. D.	0.48	14.95	75.17	0.0552	9.40	0.99	80.80	4.12	3.44	1.25	14,113	14,189	6.20	83.41
	Average	Mahoning	A. R.	1.92	15.60	72.43	0.0428	10.05	0.97	78.49	4.25	5.02	1.22	13,744	13,797	5.21	82.28
301	Masteller Coal Co. (New Creek 1)	Upper Freeport	A. D.	1.50	17.45	69.30	0.0204	11.75	3.03	76.14	4.10	3.86	1.12	13,501	13,556	4.88	79.88
301	Masteller Coal Co. (New Creek 1)	Upper Freeport	A. R.	11.04	15.76	62.59	0.0184	10.61	2.74	68.76	4.78	12.10	1.01	12,183	12,242	3.03	79.89
303	Parley Warnocks	Upper Freeport	A. D.	6.47	21.63	61.08	0.0188	10.82	0.58	69.29	3.60	14.63	1.08	11,235	11,251	2.72	73.85
303	Parley Warnocks	Upper Freeport	A. R.	15.26	19.60	55.34	0.0170	9.80	0.53	63.78	4.20	20.72	0.97	10,179	10,193	2.09	73.85
308	Grafton Mining Co. (Split-six)	Upper Freeport	A. D.	0.50	15.50	73.10	0.0330	10.90	1.78	78.83	4.18	3.17	1.14	13,750	13,706	5.60	82.51
308	Grafton Mining Co. (Split-six)	Upper Freeport	A. R.	2.83	15.15	71.36	0.0323	10.66	1.74	77.06	4.37	5.06	1.11	13,442	13,398	4.90	82.49
309	St. Cloud Coal Co. (St. Cloud 1)	Upper Freeport	A. D.	0.50	15.27	74.83	0.0380	9.40	1.32	80.28	4.35	3.58	1.07	14,148	14,206	6.18	83.05
309	St. Cloud Coal Co. (St. Cloud 1)	Upper Freeport	A. R.	2.97	14.89	72.97	0.0370	9.17	1.28	78.28	4.52	5.71	1.04	13,797	13,853	5.26	83.05
312	Eddy Coal Co.	Upper Freeport	A. D.	0.65	15.25	67.76	0.057	16.34	6.03	70.49	4.06	2.14	0.94	13,000	12,984	3.81	81.63
312	Eddy Coal Co.	Upper Freeport	A. R.	1.54	15.11	67.16	0.0566	16.19	5.98	69.86	4.11	2.93	0.93	12,884	12,868	3.65	81.63

Table of Coal Analyses, (Concluded).

(Under "Condition of Sample," "A. D." = air-dried; "A. R." = as received; "M. F." = moisture free.)

No. on Map II or IV.	Mine.	Coal Bed.	Condition of Sample.	Proximate.				Common to both.		Ultimate.				Calorimeter B. T. U. for 1 Lb. of Coal.	Calculated B. T. U. for 1 Lb. of Coal.	Fuel Ratio (Carbon Divided by Oxygen + Ash).	Carbon Ratio (Fixed Carbon Divided by Sum of F. C. and V. M.).
				Moisture.	Volatile Matter.	Fixed Carbon.	Phosphorus.	Ash.	Sulphur.	Carbon.	Hydrogen.	Oxygen.	Nitrogen.				
315	Gleason Coal & Coke Co. (No. 1)	Upper Freeport	A. D.	0.40	15.45	72.37	0.0352	11.78	2.28	78.25	4.03	2.43	1.23	13,813	13,872	5.51	82.41
315	Gleason Coal & Coke Co. (No. 1)	Upper Freeport	A. R.	5.03	14.73	69.01	0.0335	11.23	2.17	74.61	4.37	6.45	1.17	13,181	13,236	4.22	82.41
317	Schell Coal Co.	Upper Freeport	A. R.	4.00	20.10	65.00	0.0216	10.90	0.53	71.17	4.20	12.15	1.05	12,119	12,113	3.09	76.38
322	Sanford Hanlin	Upper Freeport	A. R.	0.35	19.45	69.58	0.0640	10.62	0.61	78.54	4.39	4.64	1.20	13,960	13,987	5.15	78.15
325	Herr & Co.	Upper Freeport	A. R.	0.70	16.30	70.63	0.0480	12.37	2.47	77.54	4.09	2.37	1.16	13,807	13,813	5.26	81.25
330	Chambers Tract	Upper Freeport	A. R.	3.36	22.34	62.85	0.0184	11.45	0.64	67.85	4.13	14.82	1.11	11,382	11,383	2.58	73.78
332	Davis Coal & Coke Co.	Upper Freeport	A. R.	1.92	19.28	66.40	0.0536	12.40	1.78	74.80	4.22	5.64	1.16	13,200	13,217	4.15	77.50
334	Davis Coal & Coke Co. (Rumbarger)	Upper Freeport	A. R.	7.15	24.05	59.07	0.0180	9.73	0.57	66.21	4.03	18.38	1.08	10,819	10,804	2.36	71.07
340	S. H. Jordan	Upper Freeport	A. D.	0.25	19.20	71.16	0.0648	9.39	1.64	78.84	4.64	4.18	1.31	14,062	14,155	5.81	78.75
340	S. H. Jordan	Upper Freeport	A. R.	1.52	18.95	70.26	0.0640	9.27	1.62	77.83	4.72	5.26	1.30	13,882	13,974	5.36	78.76
343	Emmons Coal Mining Co. of W. Va. (Culpepper)	Upper Freeport	A. D.	0.56	19.98	70.78	0.0148	8.68	1.40	80.00	4.39	4.16	1.37	14,100	14,116	6.23	77.99
343	Emmons Coal Mining Co. of W. Va. (Culpepper)	Upper Freeport	A. R.	2.56	19.58	69.24	0.0145	8.52	1.37	78.39	4.52	5.86	1.34	13,818	13,834	5.45	77.98
346	Davis Coal & Coke Co. No. 42	Upper Freeport	A. D.	0.71	22.92	70.08	0.065	6.29	0.36	82.75	4.85	4.70	1.05	14,850	14,690	7.53	75.35
346	Davis Coal & Coke Co. No. 42	Upper Freeport	A. R.	4.15	22.13	67.65	0.065	6.07	0.35	79.89	5.06	7.62	1.01	14,340	14,190	5.84	75.35
	Average	Upper Freeport	A. D.	1.28	18.07	70.05	0.0386	10.60	2.05	77.21	4.24	4.76	1.14	13,607	13,615	5.03	79.49
	Average	Upper Freeport	A. R.	4.29	18.50	66.61	0.0375	10.60	1.62	73.64	4.38	8.65	1.11	12,866	12,874	3.83	78.26
357	H. P. Brydon & Bro., Inc.	Upper Kittanning..	A. R.	0.50	16.15	71.02	0.0093	12.33	0.79	79.11	4.08	2.51	1.18	14,058	13,964	5.33	81.47
367	Herr & Co.	Upper Kittanning..	A. R.	0.22	15.86	72.17	0.0108	11 75	3.55	77.38	4.08	2.22	1.02	13,715	13,790	5.54	81.98
	Average	Upper Kittanning..	A. R.	0.36	16.00	71.60	0.0101	12.04	2.17	78.25	4.08	2.36	1.10	13,887	13,877	5.44	81.73
373	W. Va. Pulp & Paper Co. (No. 2 Devon)	Lower Kittanning..	A. D.	0.20	20.10	68.58	0.0104	11.12	1.94	78.83	4.12	3.05	0.94	13,869	13,950	5.56	77.33
373	W. Va. Pulp & Paper Co. (No. 2 Devon)	Lower Kittanning..	A. R.	0.77	19.99	68.18	0.0103	11.06	1.93	78.38	4.15	3.55	0.93	13,790	13,866	5.36	77.33
385	Pulliam & Ravenscroft	Lower Kittanning..	A. R.	0.54	16.71	70.65	0.0066	12.10	2.21	76.25	4.37	3.79	1.28	13,727	13,682	4.80	80.87
	Average	Lower Kittanning..	A. R.	0.65	18.35	69.42	0.0084	11.58	2.07	77.32	4.26	3.67	1.10	13,759	13,774	5.07	79.09

TABLE OF FUSING AND MELTING POINTS OF ASH.

In the following Table of Fusing and Melting Points of Ash will be found a determination of the fusing point of ash for nearly all the mines included in the preceding Table of Analyses, and in some cases the melting point of ash is indicated, this latter factor being unobtainable in the case of an ash with a high fusing point, owing to the temperature limit of the apparatus. These determinations were all made by Mr. Kaplan in an oven which has recently been installed in the Laboratory of the Survey and which is a duplicate of that used by the United States Bureau of Mines, making it possible to include this valuable feature as a regular item in the chemical analyses of West Virginia coals:

Table Showing Fusing and Melting Points of Coal Ash.

No. on Map II or IV.	Mine.	Coal Bed.	Fusing Point of Ash. °F.	Melting Point of Ash. °F.
2	Dean Coal Co. (No. 4 Tyson)	Sewickley	2671	.....
11	Virginia Big Vein Coal Co. (South)	Pittsburgh	2404	.....
12	H. P. Brydon & Bro., Inc.	Pittsburgh	2442	2515
16	Deep Run Big Vein Coal Co.	Pittsburgh	2717	.....
17	Thomas Dixon	Pittsburgh	+2717	.....
24	Smith Big Vein Coal Co. (No. 1)	Pittsburgh	+2690	.....
	Average	Pittsburgh	2594	2515
47	Nalley Tract	Little Clarksburg	+2800	.....
53	John Durham	Little Clarksburg	2118	.....
	Average	Little Clarksburg	2459	.....
74	Silver Coal Co. (No. 2)	Elk Lick	2700	.....
75	Silver Coal Co. (No. 3)	Elk Lick	2023	.....
78	Mastelier Coal Co. (No. 4)	Elk Lick	2110	.....
80	Masteller Coal Co. (No. 5)	Elk Lick	2077	.....
86	Kalbaugh Coal Co.	Elk Lick	2126	.....
87	H. P. Brydon & Bro, Inc. (Shaw)	Elk Lick	2563	.....
91	Deep Run Big Vein Coal Co. (Grant No. 1)	Elk Lick	2041	.....
92	Deep Run Big Vein Coal Co. (Grant No. 3)	Elk Lick	2126	.....
93	Jaffy Coal Mining Co. (No. 4 Swayne)	Elk Lick	1975	.....
96	Jack Jones	Elk Lick	2134	.....
97	James R. Green Heirs	Elk Lick	2525	.....
101	Mapleville Coal Co.	Elk Lick	2023	.....
102	Miller & Lemon	Elk Lick	1870	.....
103	Pritts Bros. Coal Co	Elk Lick	1985	.....
104	Clise Bros. Coal Co.	Elk Lick	2059	.....
105	Low Volatile Coal Co.	Elk Lick	2190	.....
106	Vanderber Coal & Cole Co.	Elk Lick	2390	.....
108	Mont Alto Coal Co.	Elk Lick	2150	.....
109	Bakertown Coal Co.	Elk Lick	2032	.....
113	Love Coal Co.	Elk Lick	2059	.....
122	James Shillingburg	Elk Lick	2110	.....
	Average	Elk Lick	2156	.....
150	Jack Jones	Harlem	2110	.....
195	Jaffy Coal Mining Co	Bakerstown	2050	.....
197	Deep Run Big Vein Coal Co.	Bakerstown	1914	.....

Table Showing Fusing and Melting Points of Coal Ash. (Continued.)

No. on Map II or IV.	Mine.	Coal Bed.	Fusing Point of Ash. °F.	Melting Point of Ash. °F.
202	Grafton Mining Co.	Bakerstown	2307	.....
204	St. Cloud Coal Co. (Ida)	Bakerstown	1903	.....
205	Grace Coal Co.	Bakerstown	2228	.....
206	Brady Coal Corporation (Abrams Creek)	Bakerstown	2214	.....
208	Donley Coal Co.	Bakerstown	1792	.....
212	Carroll-Cross Coal Co. (Imperial No. 2)	Bakerstown	+2680	.....
219	W. W. Kitzmiller	Bakerstown	2563	.....
221	W. H. Kitzmiller	Bakerstown	+2700	.....
224	M. F. Cosner	Bakerstown	2041	2142
225	Elmer Kuhn	Bakerstown	2527	.....
228	Herr & Co.	Bakerstown	1881	1945
230	Herr & Co.	Bakerstown	1881	1945
246	Davis Coal & Coke Co. (No. 22 Henry)	Bakerstown	2041	.....
	Average	Bakerstown	2181	2011
252	Hoffa-Martin Coal Co.	Mahoning	2539	.....
255	Twin Mountain Coal Co. (Fahey)	Mahoning	2397	.....
261	Silver Coal Co. (No. 1)	Mahoning	2500	.....
283	F. M. Reynolds	Mahoning	2647	.....
285	Fortney & Piles	Mahoning	2355	.....
287	Eddy Coal Co.	Mahoning	2493	2551
289	Gleason Coal & Coke Co. (No. 3)	Mahoning	2515	.....
	Average	Mahoning	2492	2551
301	Masteller Coal Co. (New Creek No. 1)	Upper Freeport	2404	.....
303	Parley Warnocks	Upper Freeport	2307	.....
308	Grafton Mining Co. (Split-six)	Upper Freeport	2134	.....
309	St. Cloud Coal Co. (St. Cloud No. 1)	Upper Freeport	+2700	.....
312	Eddy Coal Co.	Upper Freeport	2085	.....
315	Gleason Coal & Coke Co. (No. 1)	Upper Freeport	2435	.....
317	Schell Coal Co.	Upper Freeport	+2750	.....
322	Sanford Hanlin	Upper Freeport	2214	.....
325	Herr & Co.	Upper Freeport	2300	.....
330	Chambers Tract	Upper Freeport	+2700	.....
332	Davis Coal & Coke Co.	Upper Freeport	2134	.....
334	Davis Coal & Coke Co. (Rumbarger)	Upper Freeport	2550	.....
340	S. H. Jordan	Upper Freeport	2442	.....
343	Emmons Coal Mining Co. of W. Va. (Culpepper)	Upper Freeport	2527	.....
	Average	Upper Freeport	2406	.....
357	H. P. Brydon & Bro., Inc.	Upper Kittanning	+2717	.....
367	Herr & Co.	Upper Kittanning	2032	.....
	Average	Upper Kittanning	2375	.....
373	W. Va. Pulp & Paper Co. (No. 2 Devon)	Lower Kittanning	2400	.....
385	Pulliam & Ravenscroft	Lower Kittanning	2243	.....
	Average	Lower Kittanning	2322	.....

Page References to Detailed Descriptions and Sections of Coal Mines Listed in Preceding Tables.

No. on Map II or IV.	Sample No.	Coal Bed and Name of Owner.	Location.	Page.
		SEWICKLEY.		
2	508-R	Dean Coal Co. No. 4 Mine (Tyson Opening)	0.3 mi. S. W. of Elk Garden	513
		PITTSBURGH.		
11	468-R	Virginia Big Vein Coal Co. (South Opening)	1.2 mi. S. E. of Barnum	521
12	471-R	H. P. Brydon & Bro., Inc.	1.8 mi. E. of Shaw	521
16	467-R	Deep Run Big Vein Coal Co.	0.7 mi. E. of Nethken	522
17	466-R	Thomas Dixon	0.8 mi. N. E. of Elk Garden	523
24	509-R	Smith Big Vein Coal Co. No. 1	0.7 mi. S. of Elk Garden	525
		LITTLE PITTSBURGH.		
41	383-R	Davis Coal & Coke Co. No. 61	0.2 mi. N. of Fairfax	529
		LITTLE CLARKSBURG.		
47	540-R	Nalley Tract	2.2 mi. S. of Piedmont	532
53	472-R	John Durham	1 mi. S. E. of Shaw	533
		ELK LICK.		
74	529-R	Silver Coal Co. No. 2.	0.4 mi. S. of W. Va. Central Junc.	538
75	528-R	Silver Coal Co. No. 3	0.7 mi. S. W. of W. Va. Cent. Junc.	539
78	497-R	Masteller Coal Co. No. 4	1.5 mi. S. W. of Hampshire	539
80	498-R	Masteller Coal Co. No. 5	0.9 mi. S. W. of Hampshire	540
86	501-R	Kalbaugh Coal Co.	0.7 mi. S. E. of Barnum	542
87	507-R	H. P. Brydon & Bro., Inc. (Shaw)	0.9 mi. N. E. of Shaw	542
91	503-R	Deep Run Big Vein Coal Co. (Grant No. 1)	0.4 mi. N. E. of Nethken	543
92	504-R	Deep Run Big Vein Coal Co. (Grant No. 3)	0.3 mi. N. E. of Nethken	544
93	505-R	Jaffy Coal Mining Co. (No. 4 Swayne)	0.7 mi. N. W. of Nethken	544
96	511-R	Jack Jones	1.1 mi. S. E. of Elk Garden	545
97	473-R	James R. Green Heirs	0.6 mi. S. E. of Sulphur City	545
101	515-R	Mapleville Coal Co.	1 mi. E. of Oakmont	546
102	525-R	Miller & Lemon	0.4 mi. E. of Emoryville Station	547
103	522-R	Pritts Bros. Coal Co.	0.5 mi. S. E. of Emoryville Sta.	547
104	524-R	Clise Bros. Coal Co.	0.4 mi. S. E. of Emoryville Sta.	548
105	527-R	Low Volatile Coal Co. No. 1	0.6 mi. S. E. of Emoryville Sta.	548
106	526-R	Vanderber Coal & Coke Co.	0.9 mi. S. E. of Emoryville Sta.	549
108	475-R	Mont Alto Coal Co.	0.5 mi. N. E. of Hartmansville	549
109	518-R	Eakertown Coal Co.	0.1 mi. S. of Emoryville	550
113	523-R	Love Coal Co.	0.2 mi. N. W. of Wabash	551
122	576-R	James Sillingburg	2.1 mi. N. E. of Mount Storm	553
		HARLEM.		
150	512-R	Jack Jones	1.2 mi. S. E. of Elk Garden	559
		BAKERSTOWN.		
195	506-R	Jaffy Coal Mining Co.	0.5 mi. N. of Nethken	572
197	502-R	Deep Run Big Vein Coal Co.	0.3 mi. N. of Nethken	573
202	494-R	Grafton Mining Co. ("Freeport")	0.2 mi. S. E. of Blaine	574
204	514-R	St. Cloud Coal Co. (Ida)	0.3 mi. S. E. of Potomac Manor	575
205	521-R	Grace Coal Co.	0.3 mi. W. of Oakmont	575
206	520-R	Brady Coal Corporation (Abrams Creek)	At Oakmont	576
208	510-R	Donley Coal Co.	0.7 mi. E. of Oakmont	576
212	519-R	Carroll-Criss Coal Co. (Imperial No. 2)	0.5 mi. N. W. of Emoryville Sta.	578
218	470-R	N. B. Harvey	1 mi. N. W. of Kearney	579
219	476-R	W. W. Kizmiller	0.7 mi. S. W. of Hartmansville	580
221	479-R	W. H. Kizmiller	2.5 mi. N. E. of Mount Storm	581
224	481-R	M. F. Cosier	0.5 mi. N. E. of Bismarck	581

Page References to Detailed Descriptions and Sections of Coal Mines Listed in Preceding Tables, (Continued).

No. on Map II or IV.	Sample No.	Coal Bed and Name of Owner.	Location.	Page.
		BAKERSTOWN.		
225	478-R	Elmer Kuhn	1 mi. N. W. of Mount Storm	582
228	487-R	Herr & Co.	1.8 mi. S. W. of Bismarck	582
230	486-R	Herr & Co.	0.3 mi. above mouth of Helmick Run	583
235	469-R	Wm. Wilson	1.3 mi. N. E. of Gorman	584
246	489-R	Davis Coal & Coke Co. (No. 22 Henry)	0.3 mi. S. W. of Henry	588
		MAHONING.		
252	463-R	Hoffa-Martin Coal Co.	1 mi. S. E. of Piedmont	591
255	474-R	Twin Mountain Coal Co. (Fahey)	0.6 mi. S. E. of Piedmont	593
261	530-R	Silver Coal Co. No. 1	0.4 mi. S. of W. Va. Cent. Junc.	594
283	532-R	F. M. Reynolds	0.2 mi. S. W. of Tasker School	599
285	496-R	Fortney & Piles	Just S. of Blaine	601
287	516-R	Eddy Coal Co.	0.4 mi. S. E. of Harrison	602
289	492-R	Gleason Coal & Coke Co. No. 3	0.2 mi. S. E. of Gleason	602
		UPPER FREEPORT.		
301	499-R	Masteller Coal Co. (New Creek No. 1)	0.5 mi. S. W. of Hampshire	608
303	500-R	Parley Warnocks	At Warnocks	609
308	495-R	Grafton Mining Co. (Split-six)	0.3 mi. S. W. of Blaine	610
309	513-R	St. Cloud Coal Co. (St. Cloud No. 1)	0.2 mi. S. E. of Potomac Manor	610
312	517-R	Eddy Coal Co.	0.3 mi. S. W. of Harrison	611
315	493-R	Gleason Coal & Coke Co. No. 1	0.2 mi. S. of Gleason	612
317	477-R	Schell Coal Co.	0.2 mi. N. E. of Schell	613
322	480-R	Sanford Hanlin	0.5 mi. N. E. of Bismarck	615
325	482-R	Herr & Co.	3.2 mi. W. of Bismarck	616
330	485-R	Chambers Tract	2.4 mi. N. E. of Stony River Dam	618
332	484-R	Davis Coal & Coke Co.	1.6 mi. N. of Stony River Dam	619
334	483-R	Davis Coal & Coke Co. (Rumbarger)	0.7 mi. S. W. of Stony River Dam	619
340	491-R	S. H. Jordan	1.2 mi. N. E. of Gormania	622
343	490-R	Emmons Coal Mining Co. of W. Va. (Culpepper)	1 mi. S. E. of Bayard	623
346	387-R	Davis Coal & Coke Co. No. 42	At Kempton	624
		UPPER KITTANNING.		
357	464-R	H. P. Brydon & Bro., Inc.	0.4 mi. N. E. of Hampshire	628
367	488-R	Herr & Co.	2.8 mi. W. of Bismarck	631
		LOWER KITTANNING		
373	581-R	W. Va. Pulp & Paper Co. (No. 2 Devon)	N. E. edge of Luke	635
385	577-R	Pulliam & Ravenscroft	1.1 mi. E. of Hartmansville	638

CHAPTER XVIII.

LIMESTONE.

GENERAL STATEMENT.

The limestone resources of Mineral and Grant Counties are so large and important from an economic viewpoint that it seems advisable to assemble the essential data in one Chapter where they may be available in concise form, either by reference or direct description. In conformity with that idea previous Chapters on Stratigraphy give full descriptions of only those minor calcareous horizons which have little or no commercial significance. Next to its coal, limestone is the most valuable mineral commodity that the two counties can now offer to the markets of the country. They originally contained six principal items of natural wealth, the same being their timber, coal, limestone, agricultural soils, water-power resources, and iron ore. Of these the timber has been almost entirely removed, leaving many great barren wastes, some of which may never produce trees again. The coals are being exploited on a large scale and the agricultural soils, in many localities, have been impoverished by overcultivation and by the washing effect of heavy rains since the removal of the vegetation, although there still exist numerous fertile valleys and slopes. The original wealth of limestone, however, remains practically untouched, only a few thousand tons having been quarried. The same statement is true about iron ore except that the deposits are severely limited both as to quantity and quality. The water-power resources are still available, only a small fraction having been developed, but there are many difficulties which have prevented their exploitation and which may continue to do so.

It is thus apparent that limestone is the most hopeful mineral or natural commodity, next after coal. These deposits are located where they may be quarried to great advantage and there is trunk-line transportation on which the product may be directly loaded or to which it may be hauled by easily constructed spurs at many points.

The quality of the various limestone beds indicates that material is available from which there may be manufactured or derived natural cement, Portland cement, agricultural lime, railroad ballast, road material, concrete aggregate and many other minor items. Owing to the presence of silica, alumina, and other less abundant impurities the limestones of the two counties are not in general adapted for use as blast-furnace flux, paper or glass manufacture, or for other purposes for which a strictly pure stone is demanded. Some of them have been employed to a limited extent for local building stone but there are only occasional streaks of oolite so that a product could not be obtained that would compete with the ideal Mississippian limestones of the Middle West.

Figures 28 and 29 show at a glance the localities where large bodies of limestone outcrop in the two counties, together with the layout of the drainage. The same areas are shown in much more detail on Maps II and IV, where the geologic age, inclination of the beds, and other essential data may be studied.

CEMENT MILLS.

Within the two counties no attempt has been made to manufacture Portland cement but in Mineral County natural cement was once made at Cedar Cliff, on North Branch of Potomac River 4 miles southwest of Cumberland. This old mill has been entirely abandoned but the following description is afforded from an investigation by Dr. G. P. Grimsley, published in Volume III, pages 501-502, of the Survey Reports, dated 1905. A few parenthetic corrections have been inserted by the writer:

"The Cedar Cliff Natural Cement Company built a small mill in 1891 at Cedar Cliff, a station on the West Virginia Central & Pittsburgh Railroad (now Western Maryland Railway), four miles from Cumberland. The name was later changed to the Cumberland Valley Cement Company, and the property has been in the Receiver's hands for the past two years.

"The mill is a frame building, two and one-half stories high, containing a 120-H. P. engine, four boilers, a crusher and four runs of buhrs. It is located on the hillside above the railroad track and not far from the Potomac River.

"There are six stone kilns twenty-eight feet high and nine feet in diameter, in which the rock and fuel were placed in alternate layers. The capacity was 37 to 50 barrels of cement per kiln daily. The cement cost about 25 cents a barrel to manufacture, and it reached 115 to 140 pounds tensile strength in twenty-four hours when tested neat (without sand).

"The rock was taken from three tunnels above the mill level. These tunnels have been worked under the hill for a distance of 200 feet, running a little east of south. The rock dips at a high angle and the layers vary in composition. Some of the layers can be used alone,

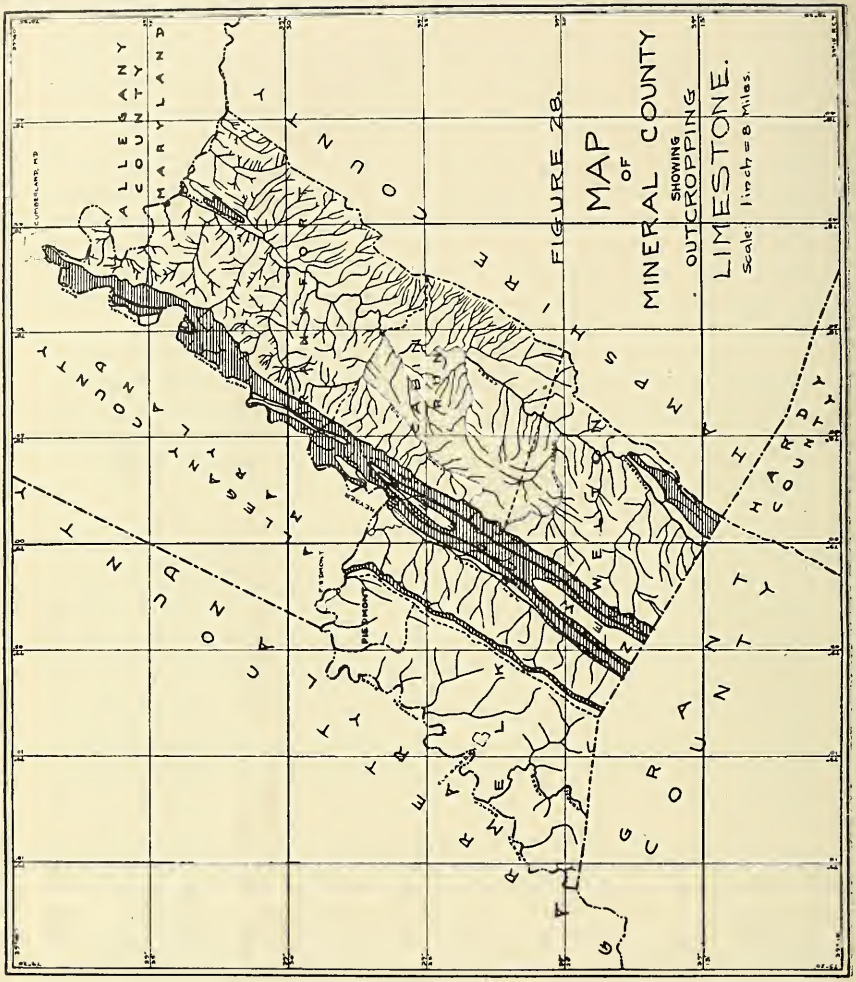


FIGURE 28.
MAP
OF
MINERAL COUNTY
SHOWING
OUTCROPPING
LIMESTONE.
Scale: 1 inch = 8 Miles.
ALLEGANY
COUNTY
MARYLAND
GARRETT
COUNTY
HAMPSHIRE
COUNTY
GRANT
COUNTY
PIEDMONT
WESTERN
MARYLAND
RAILROAD

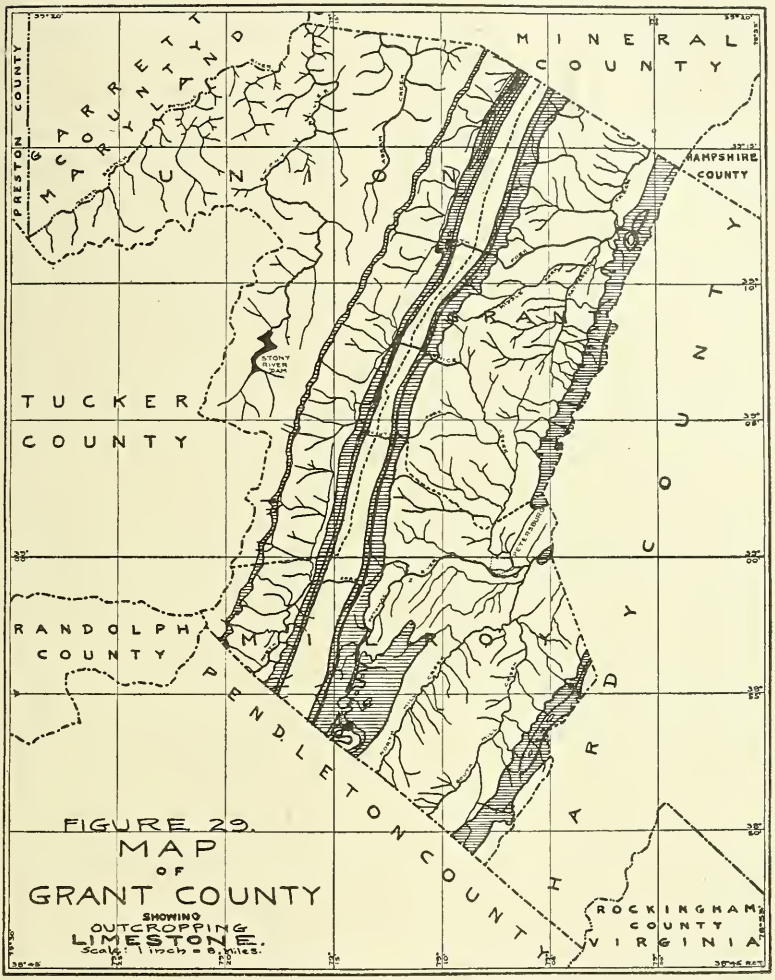


FIGURE 29.

MAP OF GRANT COUNTY SHOWING OUTCROPPING LIMESTONE.

Scale: 1 inch = 6 miles.

making a quick-setting cement, but the best results were attained by a mixture of three parts of rock in the second tunnel with one from the first tunnel. Some of the layers have no cement properties, and have to be thrown aside or left in the mine. The variation in these layers, which come close together, required careful attention and skilled workmen.

"The hill at Cedar Cliff is composed of folded strata of Lower Helderberg age (the quarry rock is Rondout Waterlime of Silurian age, 'Lower Helderberg' having been formerly used as an inclusive term), with the strike of the beds south of east. The dip of the rocks is quite steep, bringing the different strata to the railroad level, enabling one to follow the track across the section. The folded strata are illustrated in lower part of Plate XXI and in Plate XXXVII (of Volume III).

"The original promoters of the cement proposition recognized and numbered some forty-eight strata, and divided them into groups, named from their resemblance in composition and properties to other well-known natural cement horizons. Mr. J. C. Brady, the former Manager of this property, who was very successful in turning out a high-grade natural cement, has tested most of the layers and finds that many of them used alone will not make cement, and he is able to distinguish the layers and make various combinations for good cement.

"The lowest group of twenty-eight feet of rock was not used at the Cedar Cliff mill, but was named the Cumberland. The next higher eleven layers, ranging from one to eight feet in thickness, or a total of 44½ feet, were grouped as the Round Top. The next group of seventeen layers, with a total thickness of 45½ feet, was called the Ulster or Rosendale. The highest group, of nineteen layers, with a thickness of 112 feet, was not used at the mill and so received no name.

"Tunnel No. 1, near the mill, exposed the upper five layers of the Ulster, and tunnel No. 2 exposed the seven layers of the Ulster from layer No. 8 to 17. Tunnel No. 3 exposed the upper four layers of the Round Top.

"Chemical Analyses.—The following analyses of the Cedar Cliff natural cement rock were made by Dr. P. B. Wilson in 1891:

	ULSTER.	
	Stratum 14.	Stratum 17.
Silica	30.32	30.43
Alumina	4.10	5.20
Iron Oxide	2.80	4.13
Lime Oxide	36.77	30.86
Magnesium Oxide	14.67	17.69
Water and carbon dioxide	11.34	11.69
Totals	100.00	100.00

At this old plant there now remain only the six draw-kilns and the old tunnel from which the raw material was secured. As indicated in the Cedar Cliff Section, page 134, the tunnel is located 95 feet, by aneroid, above the level of North Branch and 124 feet by stratigraphic measurement above the level of the lowest visible calcareous stratum in the river bed. The tunnel cut includes 16 feet of strata, its base being 285 feet, stratigraphic measurement, below the top

of the Rondout Waterlime. It is apparent from adjacent outcrops that the limestone in the bed of the river is very near the base of the Rondout so that the ledge used for cement may be roughly considered as being 125 to 150 feet above the base of the Waterlime formation. There is at present only one tunnel visible, but it appears probable that small open cuts or prospects may have been mentioned as tunnels. According to Dr. Grimsley's description it is 118 feet, presumably from the bed of the river, to the upper Ulster layer of cement material which agrees closely with the stratigraphic measurement of the writer for the level of the old tunnel.

A sample (No. 538R) was collected by the writer from the whole face of the old tunnel and its composition is published under the name of **Cedar Cliff Cement Company,** by which the old plant is now known, in the Table of Limestone Analyses at the end of this Chapter. This analysis shows a smaller content of silica and a greater amount of alumina than either of the results obtained by Dr. Wilson. From such a comparison it would appear that the high silica streaks were sought for and used in making the cement.

At Ackerman, Mineral County, 5½ miles southwest of Cumberland and 1½ miles southwest of Cedar Cliff, the **Cumberland Portland Cement Company** once drove a tunnel in the Rondout Waterlime, at elevation 905′ B., in the face of Knobly Mountain east of North Branch of Potomac, where some limestone was removed for the experimental manufacture of cement. This old tunnel is now abandoned and fallen shut but Dr. Grimsley in Volume III, page 503, gives the following analysis of the finished cement from this point, according to J. C. Attix:

	Per cent.
Silica	27.86
Alumina	11.71
Iron oxide	2.72
Lime oxide	40.74
Magnesium oxide	13.95
Potash	1.30
Water	0.85
Total	99.13

The strata at the above point are not well enough exposed to permit a determination of the exact level of the Rondout from which this sample came. The same company now operates a large quarry in the Bossardville Limestone higher against the mountain, a description of which will be found on a subsequent page.

The **Cumberland and Potomac Cement Company** formerly mined the Rondout Waterlime beds along the Baltimore and

Ohio Railroad in Allegany County, Maryland, on the north side of North Branch of Potomac River about one-fourth mile east of Potomac Station. The old plant has long since been abandoned but the old tunnels still show the source of the raw material. Here the strata stand in an almost vertical position, their succession being indicated in the Potomac Section, page 136. At the most eastern tunnel, No. 11 of the section, a 20-foot stratum of shaly limestone has been excavated, its base being only 20 feet stratigraphically above the contact of the Rondout with the Bloomsburg Red Shale. The thin layers of limestone in the tunnel are much ripple-marked, or more properly speaking, mud-cracked, which is a prominent feature of the natural cement quarries in the same formation in New York State. A sample (No. 533R) was collected across the face of this old tunnel, the composition of which is published in the Table of Limestone Analyses at the end of this Chapter.

Just west of this first tunnel and separated from it by a stratigraphic interval of 50 feet there is a second tunnel, which also removed 20 feet of strata having the identical appearance of the eastern tunnel, even to the mud-cracks, and strongly indicating a duplication of the beds, although this may not be the case. The rock from the two tunnels was hauled by tram to the plant which was situated at the extreme eastern end of the long railroad cut. No further details about this operation are available.

LIMESTONES OF THE PENNSYLVANIAN PERIOD.

In the Pennsylvanian Period there are only a few thin and siliceous beds of limestone in the two counties, offering no prospect of commercial exploitation. All of them have been fully described in Chapters VI to IX, inclusive, references to their detailed discussion being listed in the following table:

Page References to Detailed Descriptions of Pennsylvanian Limestones.

	Pages where described.
Monongahela Series:	
Sewickley Limestone	199
Conemaugh Series:	
Fairfax Limestone	210
Ames Limestone	220-1
Albright Limestone	225
Pine Creek Limestone	225-6
Brush Creek Limestone	227-8
Sutton Limestone	229
Allegheny Series:	
Upper Freeport Limestone	239

Pages where described.
Johnstown Limestone 243
Vanport Limestone 246-7
Pottsville Series:
Mercer Limestone 261-2

LIMESTONES OF THE MISSISSIPPIAN PERIOD.

In the Mauch Chunk Series, which comes at the top of the Mississippian, only one thin limestone (Hinton?) of no possible economic value is found. This has been described in the text, pages 275-6. In the Pocono Series, which is the basal division of the Mississippian, no limestones were found.

LIMESTONES OF THE GREENBRIER SERIES.

The Greenbrier Series of the Mississippian, which has been discussed on pages 277-9, is principally calcareous, its thickness varying from 100 to 300 feet. It appears to be well suited for the manufacture of Portland cement, being so used in Preston County, and it would also make agricultural lime. As crushed stone for construction material it would be valuable where fire-proofing is not required but the general inaccessibility of most of its outcrops indicates that competition with more conveniently situated beds would hardly be possible. This limestone outcrops only along the eastern slope of the Allegheny Front, well up toward the top of the ridge, except in the gap of the Potomac between Keyser and Piedmont where it crosses the valley and is therefore on transportation. It is not well exposed at this locality, however, being almost completely covered by debris, as shown by the Keyser Section, page 140, and the same condition is found at most points along the side of the mountain farther south.

At the **Andrew Shillingburg Exposure**, on the Northwestern Pike 2.3 miles northeast of Hartmansville, Mineral County, there is an exposure of 50 feet of good limestone at the roadside, its base having an elevation of 2270′ B. The analysis of a sample (No. 550R) collected across the face of this outcrop is published in the Table of Limestone Analyses at the end of this Chapter.

Owing to the surface weathering and covered condition of the Greenbrier Limestone along this mountain extensive prospecting or core drilling would be necessary before a reliable statement as to its suitability for Portland cement could be made, although the one available analysis is favorable and it is known to be generally well adapted for cement. The existence of many more advantageous locations in the State, however, would appear to make the most of the Green-

brier outcrop of the two counties be regarded as unfavorable for such an industry, the immediate vicinity of the Baltimore and Ohio Railroad being a possible exception.

LIMESTONES OF THE DEVONIAN PERIOD.

In the Catskill, Chemung, and Portage Series of the Devonian no limestones are found. In the Genesee there are insignificant concretions and in the Hamilton there is one lenticular calcareous bed, the Landes Limestone, described on page 313.

LIMESTONES OF THE MARCELLUS SERIES.

In the Marcellus Series there occurs the Lower Selinsgrove Limestone, the detailed outcrops and exposures of which are described on pages 321-7. This horizon varies from a few feet of calcareous shale to a comparatively massive deposit of about 100 feet thickness, in which latter case it is usually double-bedded, containing a large break of black shale. It is dark, carbonaceous, and siliceous, and apparently too impure for commercial exploitation. So far as known it has not been quarried in either county. At the Smith Falls locality, along South Branch of Potomac 1.5 miles west of Petersburg, Grant County, as detailed on page 327, there is a thickness of 20 feet visible. The analysis of a sample (No. 552R), collected across the face of the outcrop on the land of Ola Smith, and published in the Table of Limestone Analyses at the end of this Chapter, shows 40.08 per cent. of silica and only 46.43 per cent. of calcium carbonate. The marked tendency of this limestone toward rapid weathering and its high silica content, make its utilization for economic purposes very doubtful, but it might possibly be used for mixing with the Helderberg or other pure limestones to get a proper Portland cement mixture.

QUARRIES AND EXPOSURES, HELDERBERG LIMESTONE.

The Oriskany Sandstone, coming between the Marcellus Series and the Helderberg Limestone, has no calcareous zones of any importance, but in the Helderberg, which has been described on pages 339-356, and which varies in thickness from 300 to 600 feet, the total mass is to some extent calcareous and with the exception of the New Scotland Chert, comprising 50 to 125 feet of the upper portion, is largely made up of pure limestone. The New Scotland is largely composed of silica, the analyses of two samples being published under the discussion of Economic Aspects of the Helderberg Limestone, page 355. The limestone proper, coming below the New

Scotland, contains in general 85 to 92 per cent. of calcium carbonate, although there are exposures where the lime content is much less. It usually contains less than 3 per cent. of magnesium carbonate, the remaining impurities being silica, alumina, iron, and other minor ingredients. Such a stone could be used for the manufacture of Portland cement by mixing the natural rock with shale or with a low-grade limestone to increase the silica and alumina. It could also be used for agricultural lime to good advantage. Its physical nature is such that it makes an ideal material for macadam roads, railroad ballast, or concrete aggregate where fire-proofing is not essential. Within the two counties it has been used for all these purposes except cement manufacture.

The following quarries and other good natural exposures in the two counties are of much interest:

Casparis Stone Company.—The plant of the Casparis Stone Company, located on the western slope of Patterson Creek Ridge, east of Patterson Creek and 1.3 miles southward from Patterson Creek Station, Frankfort District, Mineral County, was installed about 1905, according to local report. A siding more than a mile long was built from the Baltimore and Ohio Railroad near Patterson Creek Station and a somewhat elaborate crushing plant, designed to prepare commercial crushed stone, was constructed on the slope below the quarry site. This entire operation has now been abandoned and is in ruins, little information being available except the statement of residents that only a few car-loads of stone were shipped before work ceased. The appearance of the quarry, however, would indicate that a considerable amount of stone was removed. The old quarry is located at elevation 720′ B. on the western slope of the Tussey Mountain Anticline, the dip of the rocks being 41° westward, the face of the excavation being 200 feet long and its depth into the hill about 100 feet at some points. The strata exposed are as follows, in descending order:

	Feet.
1. Sandstone, massive, brown, coarse, numerous fossils, **Spirifer**, etc., **Oriskany**, visible	20
2. Limestone, hard, gray, irregular fracture, siliceous at top, botryoidal surface, with veins of calcite, numerous fossils, **Helderberg**	25

A sample (No. 543R) was collected from No. 2 of section, the composition of which is published in the Table of Limestone Analyses at the end of this Chapter. The sample shows a higher percentage of silica than of calcium carbonate, such as is occasionally found in the top of the Helderberg where it is in direct contact with the Oriskany without the usual

intervening New Scotland and Shriver Cherts. This high content of silica may have been responsible for the abandonment of the plant, although no record of the use to which the stone was put is available.

Long Brothers Lime Plant.—The Long Brothers Lime Plant, which secures its raw material from the Helderberg Limestone, is located on the south side of Turners Run of Patterson Creek near the eastern end of the gap in Knobly Mountain one-fourth mile west of Knobly village, Frankfort District, Mineral County. Here there are two stone draw-kilns lined with brick. The quarry, at elevation 900′ B., is in the top of the Helderberg, having a length of 40 feet, depth into hill 50 feet, and vertical face 40 feet. The strata dip southeastward at the rate of 33°. This plant was not in operation when examined, its product being evidently consumed locally in the Patterson Creek Valley.

Standard Lime and Stone Company.—The Standard Lime and Stone Company, of 524 Equitable Building, Baltimore, Maryland, operates large quarries and a stone-crushing plant on the south side of North Branch of Potomac River, just east of the mouth of Limestone Run and 0.6 to 1 mile east of Keyser, New Creek District, Mineral County. The base of these quarries is at the approximate level of the Baltimore and Ohio Railroad, which serves them, and the operation extends southward into a small, practically isolated, hillock which is about 150 feet high and composed of almost solid limestone without cover except a thin coating of soil. Here the rocks dip rapidly northwestward toward a sharp local syncline near the mouth of Limestone Run, their rate ranging from 60 to 80°, so that from west to east in the twin quarries the Helderberg, Bossardville, and Rondout Limestones are exposed, the western quarry being largely in the Helderberg while the Bossardville and Rondout are used at the eastern opening. Between the two there is an interval of shaly, siliceous Bossardville Limestone which is not removed. From the western end of the western quarry to the eastern end of the eastern excavation the distance is about 1100 feet and at some points the face has been worked back into the hill 400 to 500 feet. The detailed exposure of these rocks has been indicated in the Limestone Run Section, page 139. Three samples were collected, one of them (No. 534R) being from the Helderberg, No. 4 of section; another (No. 535R) from the Bossardville, No. 6 of section; and a third (No. 536R) from the Rondout Waterlime, No. 7 of section. The composition of all these samples is published in the Table of Limestone Analyses at the end of this Chapter, there being a considerable amount of silica and other inert agents which reduce the

Photo by E. E. HARRIS.

PLATE XXXVI.—Deposit of Marl bed on east side of Patterson Creek at Williamsport, Grant County, showing small caverns weathered out since deposition. See text.

amount of calcium carbonate but which probably increase the value of the stone for the particular purposes for which it is used.

According to Mr. Joseph Daiuto, Superintendent, the plant puts out crushed stone for railroad ballast and concrete aggregate, its daily capacity being 500 tons. In August, 1921, there were 45 men employed but the quarries were not in full operation. The mechanical equipment included one No. 7½ Allis-Chalmers Crusher and one No. 4 Crusher of the same manufacture, in addition to screens, elevators, rock drills, dump cars, and other minor fixtures.

John W. Keys Quarry.—The John W. Keys Quarry, located in the northern end of New Creek Mountain just west of Limestone Run and 0.5 mile southeast of Keyser, in New Creek District, Mineral County, at elevation 835′ B., has furnished a considerable amount of lime and stone for local use around Keyser but has not been active for several years. The excavation extends into the hill 150 feet and at the face is 75 feet high, the dip of the strata being northwestward at the rate of 50°, with the following section revealed in descending order:

	Feet.
1. Chert, granular, Shriver Member of Oriskany Sandstone; quarried	50
2. Concealed, mostly chert, probably New Scotland Member of Helderberg	50
3. Limestone, dark-gray, hard, quarry rock, Helderberg; bedding-planes smooth; joint-planes numerous and converging to form large, triangular blocks	50
4. Limestone, not quarried, thickness concealed	....

A sample (No. 537R) was collected from No. 3 of section, the composition of which is published in the Table of Limestone Analyses at the end of this Chapter. This sample contains 85.66 per cent. of calcium carbonate, the principal impurity being silica which is 9.58 per cent. A sample collected by Dr. G. P. Grimsley, however, from a 20-foot selected stratum at the same quarry, as published in Volume III, page 341, of the Survey Reports, shows 98.94 per cent. of calcium carbonate, this latter being probably from the lower portion of the exposed limestone and free from the infiltration of silica from the Oriskany Sandstone above.

The granular chert from the top of the quarry was used for road surfacing for which it is particularly well adapted. Some of the pure limestone was burned for quicklime in a kiln located at the quarry and much of the remainder of the stone was used for construction purposes in Keyser, the Roman Catholic Church, built in 1906, being mainly of this

material. Much stone from this point was also used as street curbing but has disintegrated badly, being mostly set up on edge instead of in its natural bedding as should have been done. Both the quarry and the lime plant have been inactive in recent years, the kiln being entirely dismantled.

Joseph Arnold Quarry.—At the Joseph Arnold Quarry, in New Creek District, Mineral County, located in the northern end of New Creek Mountain 0.3 mile southeast of Keyser and slightly east of New Creek, the strata lie approximately level being at the top of the Fort Hill Anticline, with the following section in descending order:

	Feet.
1. Soil, cherty	
2. Limestone, cherty, **New Scotland**	5
3. Limestone, hard, gray, **Helderberg**	35
4. Concealed by debris to base of quarry (895′ B.)	10

Bedding-planes at the above point are numerous and irregular so that the limestone has mainly been quarried out in small blocks. Its product was used for construction work around Keyser, the home of James Leps, near-by, reputed to have been built in 1817, being of this material. Although more than 100 years old the house shows little sign of disintegration.

Mineral County Road Quarries.—Three quarries in the Helderberg Limestone have been operated by Mineral County to secure material for macadam road construction in New Creek District. One of these is located in a gap of New Creek Mountain 1.4 miles northeast of New Creek village, at elevation 925′ B. This locality is on the western slope of the Wills Mountain Anticline but the rocks have been slightly overturned locally so that the actual dip is southeastward at a rate that varies from 68 to 75°, causing the Helderberg Limestone to rest upon the Oriskany Sandstone. A section measured from west to east across the almost vertical face of the rocks is as follows:

			Feet.
1. Sandstone, fossiliferous, **Oriskany**			100
2. Limestone, hard, siliceous, quarry rock	75′		
3. Limestone, brecciated, cherty	100	**Helderberg**	275
4. Limestone, hard, massive, quarry rock	100		

Nos. 2 and 4 of the above section are quarried and crushed on the ground and used for the roads, No. 3 being evidently considered as not sufficiently durable.

Another of these quarries is located in a gap of New Creek

Mountain, 0.6 mile southwest of New Creek village, at elevation 1010′ B. Here 50 feet of the upper portion of the Helderberg has been quarried, the dip being 55° northwestward.

A third county quarry is on the eastern side of New Creek 0.8 mile southwest of Claysville, at elevation 1140′ B., the dip being 68° northwestward. A section from west to east shows the following:

	Feet.
1. Sandstone, in creek, **Oriskany**, visible	30
2. Sandstone, in bluff east of creek, **Oriskany**	15
3. Limestone, siliceous, quarry rock, **Helderberg**	30
4. Limestone, cherty, **Helderberg**	10

The quarry at the above point goes into the hill 100 feet and is 50 feet wide by 60 feet high. The presence of a siliceous limestone at this locality as well as at the quarry 1.4 miles northeast of New Creek village, coming between the Oriskany Sandstone and a cherty stratum which may represent the New Scotland, is strongly suggestive of a recurrence of the Becraft Member of the Helderberg, which is usually absent in the two counties. No collection was made in search of its guide fossil at these quarries.

Marshall Heirs Limestone Exposure.—In Grant District, Grant County, the Helderberg Limestone has not been quarried, so far as known, but it is quite well exposed on a branch of Patterson Creek just east of Williamsport, where the rocks are rising rapidly eastward toward the Patterson Creek Mountain Anticline. Here a sample (No. 572R) was collected from the lower 100 feet of the formation, its composition being published in the Table of Limestone Analyses at the end of this Chapter. This rock contains 90.80 per cent. of calcium carbonate, there being only 0.65 per cent. of magnesium carbonate.

William Welton Lime Plant.—The William Welton Lime Plant, located on the north side of South Branch of Potomac River 0.4 mile west of Welton, in Milroy District, Grant County, at elevation 945′ B., secures its raw material from a ten-foot stratum of crystalline limestone that from its fossil content appears to be basal Helderberg, the collection made at this point by Scheffel and Price having been lost in shipment so verification of this belief has not been possible. The dip at this point is 68° southeastward as would be normally expected on the eastern slope of the Welton Anticline, but there is a further possibility of faulting, since breaks are plainly visible on the south side of the river. Here the stone is partly burned in a small draw-kiln and partly ground for raw fertilizer, being used in the local agricultural community. The analysis of a sample (No. 558R), collected across the

face of the quarried stratum, is published in the Table of Limestone Analyses at the end of this Chapter, its calcium carbonate content being 93.51 per cent.

Akum Sites Limestone Exposure.—Along the western slope of the Elkhorn Mountain Anticline the Helderberg Limestone is exposed at several small, transverse streams which cut across its highly tilted outcrop. On Spring Run of South Mill Creek, 0.6 mile southeast of Masonville, Milroy District, Grant County, there is a 200-foot ledge of it visible, at elevation 1355′ B., on the land of Akum Sites. A sample (No. 567R) was collected from this stratum, the composition of which is published in the Table of Limestone Analyses at the end of this Chapter. The calcium carbonate here is 86.37 per cent. and there is 4.97 per cent. of magnesium carbonate.

Royal Glen Land and Lumber Company Limestone Exposure.—In Milroy District, Grant County, what is apparently the basal portion of the Helderberg is exposed in a 30-foot ledge on a spur of Cave Mountain, one-fourth mile west of the Cave Mountain Anticline, at the extreme head of Sawmill Run of South Branch of Potomac River and 0.9 mile eastward from Blue Rock, at elevation 2455′ B. A sample (No. 565R) was collected from this fossiliferous ledge on the land of the Royal Glen Land and Lumber Company, the composition of which is published in the Table of Limestone Analyses at the end of this Chapter. This sample has a calcium carbonate content of 91.76 per cent., its principal impurity being 5.30 per cent. of silica.

Simon Idleman Chert Quarry.—In Union District, Grant County, the Simon Idleman Chert Quarry, located on the north side of Lunice Creek directly northwest of Brick Church, a little west of Cosner Gap, and 2.3 miles northwest of Maysville, at elevation 1575′ B., is partly Shriver Chert of Oriskany age and partly New Scotland Chert of Helderberg time, each being recorded as 50 feet thick in the Maysville Section, page 176. Twenty to twenty-five feet of this mixed material is here quarried for road surfacing on the local highways.

Simon Idleman Limestone Exposure.—In the same district and county just east of the chert quarry above described there is a fairly good exposure of the Helderberg Limestone, measuring about 370 feet, as indicated in No. 13 of the Maysville Section. A sample (No. 555R) was collected from the upper 150 feet of this ledge on the land of Simon Idleman, the composition of which is published in the Table of Limestone Analyses at the end of this Chapter. This sample contains only 80.84 per cent. of calcium carbonate, being rather high in silica as seems to be the case in all samples that include the upper portion of the Helderberg.

LIMESTONES OF THE SILURIAN PERIOD.

In the Silurian Period the Bossardville Limestone and Rondout Waterlime form thick calcareous deposits, below which comes the Bloomsburg Red Shale which has no lime. Below the Bloomsburg the Niagara Limestone is a thick formation but somewhat shaly. Still below are the Clinton, White Medina, Red Medina, and Gray Medina formations, in none of which are any limestones of commercial significance found.

QUARRIES AND EXPOSURES, BOSSARDVILLE LIMESTONE.

The Bossardville Limestone, coming at the top of the Silurian and ranging in thickness from 200 to 400 feet, is usually a dull, non-crystalline rock, often composed of thin, smooth-bedded flags without intervening streaks of shale of any perceptible thickness. On pages 377-383 it has already been described in more detail with particular respect to its stratigraphic associations. In chemical quality it is scarcely so pure as the Helderberg, there being about the same percentage of silica but more magnesium carbonate, so that many of its outcrops would doubtless be condemned as Portland cement prospects on account of this latter factor. As an agricultural lime it burns readily but its effective content is in almost direct proportion to its percentage of calcium carbonate which varies from 75 to 90. In physical character it is quite hard, the small flags breaking into somewhat angular or sometimes platy fragments under the effect of the crusher, without any large amount of waste, so that is it a good stone for ballast, road macadam, or concrete aggregate. The following quarries and special outcrops are of interest in addition to the long sections previously given in Chapter V.

Cumberland Portland Cement Company Quarry.—The Cumberland Portland Cement Company, of Cumberland, Maryland, operates a large limestone quarry in the Bossardville Limestone in Frankfort District, Mineral County, the location of the crusher being at Ackerman along the Western Maryland Railway on the south side of North Branch of Potomac River 5½ miles southwest of Cumberland. According to Charles W. Wheeler, Superintendent, the plant was established about 1904, its product being railroad ballast and concrete aggregate, with a daily production of 100 tons. Twenty men are employed in the crusher and quarry. The stone is put through a Farrell Crusher of 500 tons capacity per day of 10 hours.

The quarry is located at the edge of a wide shoulder well up toward the top of Knobly Mountain one-half mile southeast of the crusher, the elevation of its base being 1280′ B., or 575 feet above the crusher, there being a long gravity plane down the slope. At the location selected there is little cover and the top is smooth enough to permit the use of a portable churn-drill for making blast-holes. The excavation is 55 feet high by 100 feet wide and extends into the mountain 200 feet, and the limestone, which is the extreme upper portion of the Bossardville, is hard and flaggy, its color being blue on fresh fracture but weathering to gray. Converging joint-planes cause the stone to break or weather into triangular forms. A sample (No. 539R) was collected across the face of the quarry, the composition of which is published in the Table of Limestone Analyses at the end of this Chapter.

The identification of the limestone at this quarry is made certain by a fossil collection just above it, the verdict of Dr. Tilton being that the fauna is partly Helderberg and partly Bossardville with a predominance of Helderberg species, indicating that the collection was made just above the contact zone which is evidently about the top of the quarry. The dip of the strata here is 15° southeastward.

Four drill holes were made by this company to test the limestone, all starting slightly above the top of the quarry, their positions being indicated on Map II and their surface elevations recorded along with the Summarized Record of Test for Coal, page 476, where all diamond drill holes in the two counties are listed.

As has been previously stated, page 659, the same company once drove a tunnel into the Rondout Waterlime along the gravity plane at elevation 905′ B. where some stone was removed for the experimental manufacture of cement.

Standard Lime and Stone Company Quarry.—The Standard Lime and Stone Company quarries the Bossardville Limestone near Keyser, along with the Helderberg and Rondout. This operation has already been discussed under the description of Helderberg quarries, page 664.

C. G. Harmon Lime Plant.—The C. G. Harmon Lime Plant, located in New Creek District, Mineral County, in a gap of New Creek Mountain 0.3 mile east of the mouth of Block Run and 2.3 miles southwest of Keyser, at elevation 965′ B., appears to be using material from the Bossardville. This stone is gray and flaggy, the quarry being 50 feet wide by 100 feet into the hill, with a 40-foot working face, the dip of the beds being southeastward at the rate of 86°. This stone is burned in a small circular draw-kiln, the product being

locally used in the New Creek Valley. No sample for analysis was taken.

Stanley Bruce Limestone Exposure.—In Grant District, Grant County, there is a fairly good exposure of the Bossardville Limestone on a branch of Patterson Creek 0.4 mile southeast of Williamsport, between elevations 1080 and 1150′ B., the stone being partly massive and partly brecciated and containing marine fossils by which the field identification is confirmed by Dr. Prouty. The analysis of a sample (No. 571R), collected at this locality on the land of Stanley Bruce and including the main portion of the formation, is published in the Table of Limestone Analyses at the end of this Chapter.

Akum Sites Limestone Exposure.—In Milroy District, Grant County, the Bossardville Limestone is well exposed on the western slope of the Elkhorn Mountain Anticline on Spring Run of South Mill Creek 0.7 mile southeast of Masonville, at elevation 1410′ B., there being about 250 feet, or probably more than half, of the formation visible. Here the stone is partly flaggy and partly massive or brecciated. A sample (No. 568R) was collected from the exposed rock, the composition of which is published in the Table of Limestone Analyses at the end of this Chapter.

John Alt Limestone Exposure.—In Milroy District, Grant County, the Bossardville Limestone is exposed along Cave Mountain for three or four miles, there being a large quantity visible along a private road slightly east of the summit of the mountain and 1.2 miles west of Pansy, at elevation 2040′ B. Here the stone is hard, flaggy, and fossiliferous, dipping southeastward at the rate of 30°. At this locality a sample (No. 564R) was collected from a 25-foot stratum in the upper portion of the formation, the composition of which is published in the Table of Limestone Analyses at the end of this Chapter.

Simon Idleman Limestone Quarry.—In Union District, Grant County, the Bossardville has been quarried and burned for agricultural lime on the land of Simon Idleman on the north side of Lunice Creek between Brick Church and Cosner Gap and 2.2 miles northeast of Maysville. Here the stone stands on edge, the quarry being in 20 feet of strata that apparently come near the base, or at least in the lower portion of the formation. The Bossardville at this locality is hard, gray, and flaggy, as indicated in No. 14 of the Maysville Section, page 176, where its associations are noted. A sample (No. 556R) was collected across the upturned edges of this entire exposure of 411 feet, the composition of which is published in the Table of Limestone Analyses at the end of this

Chapter. This sample shows 12.04 per cent. of magnesium carbonate, as well as some silica and alumina, so that its calcium carbonate content is only 75.67 per cent.

QUARRIES AND EXPOSURES, RONDOUT WATERLIME.

The Rondout Waterlime, which comes next below the Bossardville and which varies from 200 to 400 feet thick in the two counties, is a dull, non-crystalline, flaggy rock, being at some localities quite shaly while at others it is hard and durable. It has been previously described on pages 384-391, where its stratigraphic associations and correlation have been discussed, and where its identity with the natural cement rock, or Waterlime, of Ulster County, New York, has been indicated. As already mentioned under the subject of "Cement Mills" it has been mined to some extent for natural cement in the valley of North Branch of Potomac, both on the West Virginia and Maryland sides of the river. The portions desired for cement are the shaly, magnesian streaks, which also contain some silica and alumina, and which are usually found in the lower half of the formation but appear to be only a few feet in thickness.

As material for the manufacture of Portland cement or agricultural lime it does not appear that the Rondout would be generally desirable, since the magnesia is objectionable for both these purposes and silica and alumina are not desired in the latter. At some points, however, a much purer grade of stone is indicated by the analyses so that exceptions may be made to the above statement. At some localities the stone is quite hard and durable so that it may be used for ballast, road macadam, or concrete aggregate, but careful selection of quarry sites for such a purpose is essential.

Cedar Cliff Cement Company.—The mine and exposures at the Cedar Cliff Cement Company Plant, where natural cement was once made, have already been described on pages 655-9. This plant has been abandoned for many years.

Cumberland Portland Cement Company Mine.—The experimental tunnel driven into the Rondout Waterlime along the gravity plane of the Cumberland Portland Cement Company at Ackerman, Mineral County, has already been mentioned under the subject of "Cement Mills," page 659.

Cumberland and Potomac Cement Company.—The mines of the Cumberland and Potomac Cement Company, in Allegany County, Maryland, just east of Potomac Station, have already been described under the subject of "Cement Mills," pages 659-660.

Standard Lime and Stone Company Quarries.—The quar-

ries of the Standard Lime and Stone Company in the vicinity of Keyser, where the Helderberg, Bossardville, and Rondout are all excavated and used in the same crusher, have been described under the Helderberg Limestone, pages 664-5.

Stanley Bruce Limestone Exposure.—In Grant District, Grant County, the Rondout Waterlime is quite well exposed on a short branch of Patterson Creek 0.6 mile southeast of Williamsport, between elevations 1080 and 1155′ B., the rise of the rocks southeastward toward the Patterson Creek Mountain Anticline being rapid so that the formation outcrops quickly. Here it is flaggy and dark, with some streaks of shale, there being fossils near the base by which its identification is confirmed. A sample (No. 570R) was collected at this point from the lower 200 feet of the deposit, its composition being published in the Table of Limestone Analyses at the end of this Chapter.

Angus Mathias Limestone Exposure.—In Grant District, Grant County, the Rondout Waterlime is entirely exposed in the public road on the top of Patterson Creek Mountain 2 miles east of Forman, at elevation 1725′ B. Here the beds dip northwestward at the rate of 25°, the stone being dark and hard with a few small fossils near the base, and having a thickness of 323 feet. Just to the northward a large sink is scoured out in the same formation. A sample (No. 545R) was collected across the outcrop along the public road through the land of Angus Mathias, the composition of which is published in the Table of Limestone Analyses at the end of this Chapter.

Akum Sites Limestone Exposure.—In Milroy District, Grant County, the Rondout Waterlime is again well exposed on the western flank of the Elkhorn Mountain Anticline at the head of Spring Run of South Mill Creek 0.8 mile southeast of Masonville, at elevation 1435′ B. Here the upper (western) portion of the formation is hard, dark, and flaggy, with a few marine fossils, but toward the basal (eastern) portion it is shaly. A sample (No. 569R) was collected from 200 feet of the upper portion on the land of Akum Sites, its composition being published in the Table of Limestone Analyses at the end of this Chapter. This sample shows 96.00 per cent. of calcium carbonate, being the purest sample of limestone found in the two counties.

QUARRIES AND EXPOSURES, NIAGARA LIMESTONE.

The Niagara Limestone, previously described on pages 398-404, varies from 150 to 400 feet in thickness, being usually 250 to 300. It is a mass of wavy-bedded or flaggy, calcareous material, some layers of which are dense crystalline limestone

while others are quite shaly. It is easily identified because of its position between the Bloomsburg Red Shale above and the Clinton Series below, both of which are sandy or shaly material. So far as known this limestone has not been quarried for any purpose in Mineral and Grant Counties, since it is usually too shaly for construction material and too low in calcium carbonate for the manufacture of agricultural lime in competition with the Helderberg and other beds. Its thickness and character are recorded in several of the measured sections of Chapter V and at the reference cited above its detailed outcrops are elaborated.

Calvin Lyons Limestone Exposure.—There is a further good exposure of a considerable part of the Niagara in Union District, Grant County, on the west side of a branch of North Fork of Patterson Creek 1.5 miles southwestward from Greenland, at elevation 1705′ B. Here the strata dip northwestward at the rate of 65°, there being 200 feet of the Niagara exposed, the lower part of the formation being concealed by debris. Here it is flaggy, gray, and fossiliferous, with numerous streaks of shale. A sample (No. 560R) was collected from the limy layers across the face of the outcrop, on the land of Calvin Lyons, the composition of which is published in the Table of Limestone Analyses at the end of this Chapter. The sample shows 77.99 per cent. of calcium carbonate, there being 9.74 per cent. of silica and 5.24 per cent. of alumina but only 1.90 per cent. of magnesium carbonate. Such an analysis at once suggests the possibility of Portland cement manufacture, since it is quite probable that the inclusion of the shaly streaks would have reduced the calcium carbonate to 60 or 65 per cent. which would be ideal and at the same time the silica and alumina would be increased, there being necessary 20 to 25 per cent. of the former and 5 to 10 per cent. of the latter. Even if the proper percentages of these three ingredients should not prove to be present, an artificial mixture could be made by adding a small amount of shale, possibly from the Bloomsburg, or if this should have too much iron or alumina it could be obtained from the shales of the Middle or Upper Devonian or from the Clinton.

The locality named above is not regarded as suitable for a cement mill location, since it is far removed from transportation and has other disadvantages that would remove it from serious consideration, but the analysis is of much interest on account of the probably similar composition of the limestone at more convenient points for quarrying, operating, and shipping.

MARLS.

Marl is a soft calcareous deposit probably derived in part from particles of limestone carried by percolating water from the original beds and in part from carbonic acid gas which is assimilated from limestone spring waters by algae and afterward precipitated as calcium carbonate. Regardless of whether it is merely a mechanical breaking up of the limestone followed by its transfer to a new locality or whether there is first a chemical solution and a later precipitation, its source is from the bedded limestones. From these it is carried in some form by water and finally deposited when the liquid becomes overloaded.

In Mineral and Grant Counties there are only a few beds of marl, although limestone is abundant and limestone springs are numerous. The observed localities are as follows:

Williamsport Marl Bed.—At Williamsport, Grant District, Grant County, there is a considerable bed of marl located just east of Patterson Creek and directly beneath part of the town site. Here a small tributary with a swift current flows westward from Patterson Creek Mountain, passing over the upturned edges of the Niagara, Rondout, Bossardville, and Helderberg Limestones, its flow being greatly augmented by a large limestone spring which issues near the Helderberg-Bossardville contact less than one-fourth mile east of the village. Reaching the base of the mountain in the village the stream divides, one branch continuing westward to Patterson Creek and the other flowing northwestward through the town and reaching the creek 0.4 mile farther north. In the southern half of the triangle formed by these two branches and the creek the soil is almost entirely composed of marl, the difference in level between the creek and the highest part of the marl being about 65 feet, while the greatest length is perhaps 1000 feet and the greatest width about 500 feet. Owing to the concealed original contour of the ground, however, a reliable estimate of the quantity of marl available could hardly be made without using a drill or digging a pit to prospect it. The deposit is a yellow, earthy color, cavernous in part, and having well-exposed stalactites and stalagmites, and being cemented into a fairly compact bulk. A sample (No. 546R) was collected from the cliff facing Patterson Creek near the mouth of the southern stream, on the land of **V. W. Marshall**, the composition of which is published in the Table of Limestone Analyses at the end of this Chapter. Its content of calcium carbonate is 95.83 per cent. which is 6.61 per cent. higher than the average analyses of the Helderberg, Bossardville, and Rondout Limestones which were sampled just east of it, the con-

clusion being apparent that only some of the better portions of the limestones have been washed out by the big spring, which is evidently the principal carrier of the marl.

Blue Rock and Peacock Cave Marl Beds.—On the east side of South Branch of Potomac River in the Smoke Hole Settlement of Milroy District, Grant County, there is a small deposit of marl just north of Blue Rock. Here the steep slope of Cave Mountain descends abruptly to the river, the flood-plain on this side being entirely scoured away so that the marl is a comparatively fragmentary accumulation among the limestone boulders and other debris that litter the lower slope of the mountain. As indicated by Map IV, both the Helderberg and Bossardville Limestones outcrop on the face of this mountain along the Blue Rock Syncline, both being very much fractured. At the marl bed there is no large spring but there are small seepages of water which are probably responsible for the deposit.

In the Peacock Cave, which is situated in a promontory of Cave Mountain 0.5 mile northwest of Blue Rock and one-third mile northwest of the marl bed above mentioned, and which has an elevation of 1755′ B., its level being about 700 feet above South Branch, there are irregular deposits of soft, yellowish marl filling some of the crevices. Some of these beds are two feet or more in thickness and are visible for lengths of 100 feet or more, their lateral extent being entirely unknown. Farther back in the cavern, which was penetrated to a measured distance of 760 feet, the same or similar marl beds are impregnated with enough iron to make them brick-red and to classify them as ocher and they will be discussed under the latter heading on a subsequent page. A sample (No. 561R) was collected from the yellow marl in this cave, which is the property of the Royal Glen Land and Lumber Company, its composition being published in the Table of Limestone Analyses at the end of this Chapter. The calcium carbonate is 80.85 per cent. and is probably in excess of that of the original limestone, since the cave is in the upper part of the Helderberg, its mouth being in the Keyser Member and only 5 feet below the base of the New Scotland Chert. Samples collected in this zone of the Helderberg at other points are usually high in silica. This deposit of marl is of no special economic significance, the sample having been taken to determine its value as an ocher, but there is only 1.63 per cent. of ferric iron.

SUMMARY OF LIMESTONE OUTCROPS.

The following table is compiled to show the linear miles of outcrop of the five limestone formations that are regarded as sufficiently pure to be used for some commercial purpose. The figures were obtained by following with a measuring machine the indicated outcrops of each formation on Maps II and IV:

Table Showing Miles of Limestone Outcrop, Mineral and Grant Counties.

District.	Greenbrier.	Helderberg.	Bossardville.	Rondout.	Niagara.	Totals.
Mineral County:						
Frankfort	.....	26.0	19.0	9.5	5.0	59.5
Cabin Run	.....	8.3	2.3	.....	.....	10.6
Welton	.....	12.5	.....	.....	.....	12.5
New Creek	12.5	35.0	28.6	32.5	30.6	139.2
Totals, Mineral County	12.5	81.8	49.9	42.0	35.6	221.8
Grant County:						
Grant	.....	33.8	32.6	30.0	21.3	117.7
Milroy	3.5	48.7	39.6	35.0	26.7	153.5
Union	24.0	21.3	22.1	22.4	23.2	113.0
Totals, Grant County	27.5	103.8	94.3	87.4	71.2	384.2
Grand Total, both Cos.	40.0	185.6	144.2	129.4	106.8	606.0

The outcrops indicated in the above table vary from the bare thicknesses of the formations, in regions where the angle of dip approaches closely to 90°, to broad belts a half mile or more in width where the beds are approximately level, as is the case where the axes of anticlines coincide with mountain ridges and the rocks have been eroded down to some calcareous formation. Under such conditions there is no rational method by which an approximate estimate of available quarrying tonnage may be reached. In Mineral County there are fewer miles of outcrop than in Grant but the exposures are much more favorably situated with reference to natural locations for railroad spurs and quarry sites so that the available material may be regarded as much the same in each county. If all this limestone should be found useful it is quite probable that 5 billion tons might easily be quarried in each county.

TABLE OF LIMESTONE ANALYSES.

The following table gives in compact form the results of chemical tests made on the limestones of Mineral and Grant Counties, the samples having been taken in the field by the writer and the analyses made by Mr. B. B. Kaplan, Chemist of the Survey. Following the table are brief references to the formation and portions of the same sampled, property ownership, locality of outcrop or quarry, and page of the text where described in full, the key numbers being the same as those in the left-hand column of the table. The table also includes two samples of marl, which is derived from limestone and which requires the same kind of analysis:

Table of Limestone Analyses, Mineral and Grant Counties.

Reference Number.	Name of Limestone.	Silica. (SiO_2)	Ferric Iron. (Fe_2O_3)	Alumina. (Al_2O_3)	Calcium Carbonate. ($CaCO_3$)	Magnesium Carbonate. ($MgCO_3$)	Potassium Oxide. (K_2O)	Sodium Oxide. (Na_2O)	Titanium. (TiO_2)	Phosphoric Acid. (P_2O_5)	Loss on Ignition.	Total.
1	Greenbrier	12.34	1.64	1.74	81.76	2.52	.....	.....	.....	.....	0.12	100.12
2	Lower Selinsgrove	40.08	4.21	7.22	46.43	2.03	.....	.....	.....	0.11	0.47	100.55
3	Helderberg	53.40	3.04	2.66	38.19	1.98	*0.19	.....	.....	0.22	0.16	99.84
4	Helderberg	24.80	1.47	3.84	64.53	3.23	0.82	0.15	0.33	0.16	0.68	100.01
5	Helderberg	9.58	0.65	1.19	85.66	1.80	0.28	0.64	.....	0.16	0.26	100.22
6	Helderberg	5.94	1.40	1.44	90.80	0.65	.....	.....	.....	0.06	0.18	100.47
7	Helderberg	2.92	0.93	1.79	93.51	0.86	.....	.....	.....	0.02	0.19	100.22
8	Helderberg	5.30	0.93	1.25	86.37	4.97	.....	.....	.....	0.02	1.25	100.09
9	Helderberg	5.30	0.46	1.00	91.76	0.47	.....	.....	.....	0.03	0.69	99.71
10	Helderberg	12.10	0.94	0.70	80.84	1.69	.....	.....	.....	0.16	0.85	97.28
Ave.	Helderberg	14.92	1.25	1.73	78.96	1.96	0.43	0.40	0.33	0.10	0.53	99.73
11	Bossardville	2.06	2.34	2.67	89.69	2.86	.....	.....	.....	0.09	0.15	99.86
12	Bossardville	5.62	1.05	1.82	77.24	5.99	*1.47	.....	.....	0.03	6.51	99.73
13	Bossardville	10.86	1.05	1.95	85.91	0.37	.....	.....	.....	0.01	0.05	100.20
14	Bossardville	6.22	1.05	1.95	90.48	0.41	.....	.....	.....	0.03	0.10	100.24
15	Bossardville	4.88	1.00	1.22	86.80	5.00	.....	.....	.....	0.03	0.48	99.41
16	Bossardville	7.80	0.58	3.64	75.67	12.04	.....	.....	.....	.....	0.28	100.01
Ave.	Bossardville	6.24	1.18	2.21	84.30	4.45	1.47	.....	.....	0.04	2.09	99.91
17	Rondout	11.98	2.29	11.51	47.01	24.62	1.43	0.16	.....	0.098	0.70	99.80
18	Rondout	14.50	2.57	6.51	71.38	2.65	1.00	0.25	0.20	trace	0.88	99.94
19	Rondout	10.50	1.39	4.69	79.20	3.04	1.00	0.16	.....	0.06	0.10	100.14
20	Rondout	4.25	1.74	2.36	90.94	0.71	.....	.....	.....	0.02	0.26	100.28
21	Rondout	3.20	0.93	4.15	90.30	1.25	.....	.....	.....	0.16	0.28	100.27
22	Rondout	2.04	0.70	1.10	96.00	0.40	.....	.....	.....	0.01	0.11	100.36
Ave.	Rondout	7.75	1.60	5.05	79.14	5.45	1.14	0.19	.....	0.07	0.39	100.13
23	Niagara	9.74	2.40	5.24	77.99	1.90	.....	.....	.....	0.03	1.97	99.27
24	Marl	0.88	0.35	0.11	95.83	1.39	.....	.....	.....	0.16	0.91	99.63
25	Marl	9.90	1.63	5.15	80.85	1.00	0.49	0.32	.....	.....	0.41	99.75
Ave.	Marl	5.29	0.99	2.63	88.34	1.20	0.49	0.32	.....	0.16	0.66	99.69

* Includes Sodium.

1. Greenbrier, Andrew Shillingburg, Northwestern Pike, 2.3 miles N. E. of Hartmansville, Mineral County; described on page 661.

2. Lower Selinsgrove, Ola Smith, South Branch of Potomac, 1.5 miles west of Petersburg, Grant County; described on page 662.

3. Helderberg (upper portion), Casparis Stone Company, Patterson Creek, 1.3 miles south of Patterson Creek Station, Mineral County; described on page 663.

4. Keyser Member of Helderberg (upper two-thirds), Standard Lime and Stone Company, North Branch of Potomac 0.7 mile east of Keyser, Mineral County; described on page 664.

5. Keyser Member of Helderberg (upper portion), John W. Keys, North Branch of Potomac, 0.5 mile southeast of Keyser, Mineral County; described on page 665.

6. Helderberg (lower 100 feet), Marshall Heirs, Patterson Creek just east of Williamsport, Grant County; described on page 667.

7. Helderberg (lower portion), Wm. Welton, South Branch of Potomac, 0.4 mile west of Welton, Grant County; described on page 667.

8. Helderberg (200-foot ledge), Akum Sites, Spring Run of South Mill Creek, 0.6 mile S. E. of Masonville, Grant County; described on page 668.

9. Helderberg (30-foot ledge in lower portion), Royal Glen Land and Lumber Company, Cave Mountain, 0.9 mile east of Blue Rock, Grant County; described on page 668.

10. Keyser Member of Helderberg (upper 150 feet), Simon Idleman, Lunice Creek, 2.2 miles N. W. of Maysville, Grant County; described on page 668.

11. Bossardville (upper 55-feet), Cumberland Portland Cement Company, Knobly Mountain, 0.5 mile S. E. of Ackerman, Mineral County; described on pages 669-70.

12. Bossardville (entire), Standard Lime and Stone Company, North Branch of Potomac, 0.8 mile east of Keyser, Mineral County; described on page 664.

13. Bossardville (main portion), Stanley Bruce, branch of Patterson Creek, 0.4 mile S. E. of Williamsport, Grant County; described on page 671.

14. Bossardville (250-foot ledge), Akum Sites, Spring Run of South Mill Creek, 0.7 mile S. E. of Masonville, Grant County; described on page 671.

15. Bossardville (25 feet of upper portion), John Alt, Cave Mountain, 1.2 miles west of Pansy, Grant County; described on page 671.

16. Bossardville (20 feet of lower portion), Simon Idleman, Lunice Creek, 2.1 miles N. W. of Maysville, Grant County; described on page 671.

17. Rondout (16-foot tunnel, 125 to 150 feet above base of formation), Cedar Cliff Cement Company, North Branch of Potomac at Cedar Cliff, Mineral County; described on pages 658-9.

18 Rondout (20-foot tunnel, 20 feet above base of formation), Cumberland and Potomac Cement Company, North Branch of Potomac, one-fourth mile east of Potomac Station, Allegany County, Maryland; described on pages 659-60.

19. Rondout (upper 144 feet), Standard Lime and Stone Company, North Branch of Potomac, 0.9 mile east of Keyser, Mineral County; described on pages 664-5.

20. Rondout (lower 200 feet), Stanley Bruce, branch of Patterson Creek, 0.6 mile S. E. of Williamsport, Grant County; described on page 673.

21. Rondout (entire), Angus Mathias, Patterson Creek Mountain, 2 miles east of Forman, Grant County; described on page 673.

22. Rondout (200 feet of upper portion), Akum Sites, Spring Run of South Mill Creek, 0.8 mile S. E. of Masonville, Grant County; described on page 673.

23. Niagara (upper 200 feet), Calvin Lyons, branch of North Fork of Patterson Creek, 1.5 miles S. W. of Greenland, Grant County; described on page 674.

24. Marl, V. W. Marshall, Patterson Creek at Williamsport, Grant County; described on pages 675-6.

25. Marl, Royal Glen Land and Lumber Company, Peacock Cave in Cave Mountain, 0.5 mile N. W. of Blue Rock, Grant County; described on page 676.

CHAPTER XIX.

WATER-POWER, MINERAL WATERS IRON ORE, PRECIOUS METALS AND FORESTS.

WATER-POWER.

Available Streams.

No utilization of the streams of Mineral and Grant Counties for hydroelectric power has been made. In the region east of the Allegheny Front, however, where local coal is nowhere available, water-wheel mills have been built at several points to grind grain, saw lumber, and to drive light machinery for other purposes. One of these is located at Antioch, Mineral County, on the waters of Mill Creek of Patterson Creek, being used to drive the spindles of a small textile mill, the location being at the eastern base of Knobly Mountain where the stream breaks across the outcrop of the Oriskany Sandstone. At Maysville, Grant County, it is reported that Hon. Arnold C. Scherr once used the waters of Lunice Creek to run a small woolen-mill, the location being at the base of Knobly Mountain with precisely the same conditions as at Antioch. At the present time this water is used at the sawmill of the Noah May estate and is also carried by a long flume to the Hampstead Brothers mill at the eastern end of Maysville, there being an auxiliary steam plant. At Petersburg the water of South Branch of Potomac River is used to run the local grain mill, and at Masonville, Grant County, the flow of Spring Run of South Mill Creek drives a small sawmill.

In the two counties the streams worthy of attention for commercial power development are North Branch of Potomac River and Stony River which is its largest tributary, South Branch of Potomac River and North Fork which is its main feeder in the area under discussion. Besides these principal streams there are numerous localities east of the Allegheny Front where small streams could be used to good advantage for local power, since there is no coal and there are many natural water-power sites.

North Branch of Potomac River.—The drainage basin of North Branch of Potomac River has already been described pages 52 to 69, inclusive, there having been gaging stations at Piedmont, West Virginia, and Cumberland, Maryland, kept for a number of years but not now active. The available records of these two stations have been published under the description of the river. On pages 11 to 13 will be found the rainfall records for Piedmont and Burlington, Mineral County, and on pages 22 to 23 those for Bayard, Grant County, all being on the drainage of North Branch.

There is no doubt that this river is capable of furnishing a large amount of power and that many good dam sites are available but it is by no means certain that hydroelectric development on a large scale would be advisable, even though it be admitted that there is a good demand for power. Above Piedmont any large dam built along this river would flood not only the tracks of a trunk line railroad but also would, at most points, cover the outcrops of one or more valuable coal seams so that riparian damages would in most instances be heavy. On that portion of the river below Piedmont and continuing to its junction with South Branch of Potomac there are two trunk line railroads and much other culture along the immediate valley and on low tributaries, the flooding of all of which would involve enormous claims for damages. It is quite possible, however, that some low dams, giving a head of not more than 10 to 15 feet could be built at some points where only small damage would result, and this would appear to be the most practical method of utilizing the river.

Stony River.—Stony River is the largest tributary of North Branch of Potomac River within the area under discussion, Savage River being much the same size but lying wholly in Maryland. The drainage basin of Stony River has already been described, page 71, the wild and desolate nature of the country being mentioned together with the fact that the immediate valley is almost totally uninhabited. On the lower portion of this river there is little culture that would interfere with any projected scheme of hydroelectric development but there are undeveloped coals which would be flooded and for which comparatively heavy claims for damages would no doubt be demanded. From a purely engineering standpoint there are many locations where dams could be built on good foundations across the narrow valley. The upper portion of this river, where the descent is less abrupt and the valley is wider, is already preempted by the large storage reservoir of the West Virginia Pulp and Paper Company.

South Branch of Potomac River.—The drainage basin of South Branch of Potomac River has already been described, pages 72 to 73. This stream traverses Grant County for many miles, its valley between the Grant-Hardy County Line and Royal Glen Mill being generally wide and cultivated as farming land, the town of Petersburg being largely on the flood-plain. It would be possible to build an enormous dam in the gap where the river breaks through the southern end of Patterson Creek Mountain two miles east of Petersburg, but such a structure would flood not only the town but also the railroad tracks and an immense amount of valuable farming land, so that such a project would appear ill advised.

From Royal Glen Mill to the Pendleton County Line, however, the valley becomes almost gorge-like in character, there being in this whole distance only a few acres of tillable land, together with the few houses that comprise this portion of the Smokehole Settlement, as it is called. Along this part of the river there is some timber, the removal of which would no doubt be difficult, but otherwise there is no serious obstacle against the use of the valley for hydroelectric purposes, unless there should prove to be limestone caverns through which stored water might be diverted.

At Royal Glen Mill a power project has been planned by the Community Power Company, of Petersburg, West Virginia, its application for a construction permit, filed with the Public Service Commission of West Virginia and published in the Grant County Press of September 16, 1921, calling for a dam approximately 20 feet high with an associated hydroelectric power-plant. At this locality the rocks of the Lower Devonian are rising rapidly westward toward the Royal Glen Anticline, there being bluffs both north and south of the river. At the south end of the proposed dam the bluff is entirely composed of Oriskany Sandstone its contact with the New Scotland Chert of the Helderberg being at the low-water level of the shallow river. Here the Oriskany bluff has a height of 77 feet above low water, as measured by hand-level, but at a point 200 feet westward there appears to be about 100 feet of Oriskany resting on a visible thickness of 25 feet of chert so that a greater head of water could be secured.

At the north end of the proposed dam the following section, measured with hand-level and arranged in descending order, is visible:

	Thickness. Feet.	Total. Feet.
1. Sandstone, Oriskany, from top of bluff	95	95
2. Chert, New Scotland	15	110
3. Concealed to low water (961′ L.)	18	128

No. 3 of the above section is undoubtedly part of the New Scotland Chert but is concealed by sand and river wash. Farther west on this side of the river the bluff has a greater height. It is apparent from these observations that a dam at least 75 feet high could be built at the proposed location or if the site be moved slightly westward a greater head could be obtained. A safe foundation in the New Scotland Chert or the Keyser Member of the Helderberg Limestone would be almost a certainty at either point.

A dam 20 feet in height, as proposed, would impound the water only to the vicinity of the mouth of North Fork, but a 75-foot dam would back it up nearly to Redman Run. Above this point there are suitable narrows where another dam of equal height could be built if desired.

North Fork of South Branch of Potomac River.—The drainage basin of North Fork of South Branch has already been described, pages 73 to 74. The portion of this stream passing through Grant County has an extremely rugged valley along which there are many narrows where the highway has been placed well up against the mountain to get over the bluffs. It is but sparsely settled and the land has little value either for agricultural or mineral purposes so that its use for hydroelectric purposes would be easily feasible.

Indicated Horse-Power of Streams.

The following table, showing indicated horse-power developed by streams flowing through Mineral and Grant Counties, is compiled from Tables 21-24, inclusive, pages 433-436, inclusive, of the Semi-Centennial History of West Virginia by Dr. J. M. Callahan, the tables in question being part of a special article on "Water-Power Resources" by A. H. Horton, District Engineer, Water-Resources Branch, United States Geological Survey. From the original tables there have been eliminated all tributary streams and sections of both North and South Branches of Potomac which lie wholly outside the limits of the two counties, but sections of these rivers that come partly within and partly without the county boundaries are included, the effort being made to set forth, as closely as the divisions of Mr. Horton permit, the water-power resources of the two counties:

Indicated Horse-Power Developed by Streams of Mineral and Grant Counties.

Stream	Section		Length. Miles.	Mean Drainage Area. Sq. Mi.	Minimum Discharge. Sec.-Ft.	Assumed Discharge for Maximum Development. Sec.-Ft.	Total Fall. Feet.	Minimum Horse-Power.	Assumed Maximum Development. Horse-Power.	Horse-power available from storage for		
	From	To								12 months.	6 months.	3 months.
North Branch Potomac River	Source	Above Stony River	12	*93	9.3	55	1,000	214	1,270			
North Branch Potomac River	Below Stony River	Above Abram Creek	6½	168	16.8	99	420	650	3,830			
North Branch Potomac River	Below Abram Creek	Above Savage River	15	255	25.5	154	710	1,660	10,100			
North Branch Potomac River	Below Savage River	Cumberland	29	590	59.0	348	350	1,900	11,200			
North Branch Potomac River	Cumberland	Mile 180	7	945	94.5	560	63	545	3,250			
North Branch Potomac River	Mile 180	Above South Branch	10½	1,180	130.	700	25	299	1,610			
Totals			80				2,568	5,268	31,260			
Stony River	Source	North Branch Potomac River	27	*59	5.9	35	1,900	258	1,530			
Abram Creek	Source	North Branch Potomac River	19	*37	3.7	22	1,650	141	835			
New Creek	Source	North Branch Potomac River	18	*56	5.6	33	1,250	161	948			
Patterson Creek	Source	Above Mill Creek	25	*130	16.9	59	1,700	660	2,310			
Patterson Creek	Below Mill Creek	North Branch Potomac River	21½	217	28.2	98	290	752	2,610			
Totals								1,972	8,233			
South Branch Potomac River	Below Thorn Run	Above North Fork South Branch Potomac River	35	236	30.7	107	810	2,280	7,970			
South Branch Potomac River	Below North Fork	Romney	40½	1,025	131.	459	†323	3,890	13,600	10,600	21,200	42,400
Totals			75½				1,133	6,170	21,570	10,600	21,200	42,400
North Fork South Branch Potomac River	Below Seneca Creek	South Branch Potomac River	18	*280	36.4	126	550	1,840	6,380			
Lunice Creek	Source	South Branch Potomac River	20	92	12.0	41	2,000	551	1,900			
North & South Mill Creeks	Source	South Branch Potomac River	25	100	13.0	45	2,000	597	2,060			
Totals								2,988	10,340			

* Total Area. † Fall reduced to 223 feet by proposed reservoir.

MINERAL WATERS.

Mineral and Limestone Springs.

Within the two counties there is an almost total absence of mineralized springs. Along the road which leads from Keyser southeastward toward Headsville Dr. White (see North Potomac Section, page 149) reports a strong salt spring in the Salina beds along Limestone Run, there having been salt manufactured from it in the early days. The use of this spring for such a purpose appears now to have been entirely abandoned.

On a branch of Staggs Run of Patterson Creek, 2 miles southwest of Headsville, and 0.8 mile southeast of Eureka School, Mineral County, there is a small red sulphur spring which has been mistaken locally for a petroleum seepage. This spring was almost entirely dry when visited in August, 1921, and does not appear to have any possibilities for exploitation.

There are also numerous small springs carrying sulphurous material in the coal-bearing lands of both counties, such as invariably accompany these deposits, but they have no significance as mineral waters.

Limestone springs of large volume and doubtless of much purity except for their included calcareous or magnesian matter are common in those portions of both counties east of the Allegheny Front. In Mineral County the city of Keyser obtains its water from a large limestone spring at the head of Limestone Run. In Grant County the presence of a strong spring just east of Williamsport, giving rise to a marl deposit, has already been mentioned. In the same county there is another coming from near the base of the Helderberg Limestone on the north side of North Fork of South Branch of Potomac River, 0.8 mile southwest of Corners. Its capacity in September, 1921, appeared to be as much as 200 barrels per hour. In the same county there is another great spring coming out from near the Helderberg-Bossardville contact on Spring Run of South Mill Creek, 0.4 mile southeast of Masonville, its capacity in the same month being estimated as 500 barrels per hour.

Possible Sources of Mineral Waters.

Little is known concerning the underground mineral waters of the two counties. In Mineral County, as detailed in Chapter XVI, there have been two or three wells drilled for oil but the detailed records are not available to know whether brine was found. In the George Biser well near Headsville there is a light stream of clear, but slightly sulphurous, water

flowing out of the old casing-head, its source being apparently in the Devonian shales. In Grant County no deep wells have been drilled but the records of two wells near Steyer and Gorman, Maryland, adjacent to the county line, have been published in Chapter XVI. These records do not show that salt water was found, although both holes went through the sands that often contain it in the oil fields of the western counties.

It is probable that the most hopeful source of brine would be in the Williamsport Sandstone Member of the Bloomsburg Red Shale. The Bloomsburg is a portion of the Salina Beds of New York State where great quantities of rock salt and salty brines containing valuable medicinal salts of different kinds are found. In the Potomac region such inclusions are not commonly reported in the Salina Beds but the presence of brine in the vicinity of Keyser indicates that it may not be entirely lacking elsewhere. This locality is near the Wills Mountain Anticline where the upturned edges of the Bloomsburg sediments are subject to the leaching effect of meteoric water which has probably served to bring out the salty matter that is present. Other localities could be found where the Williamsport Sandstone lies below the surface with a neighboring outcrop on higher ground so that an artesian flow might be expected, provided brine actually exists in the rock.

Generally considered, however, the two counties do not appear to have indications of mineral waters of much value, such as are common in some of the southern counties of the State.

IRON ORE.

General Statement, Iron Ore.

Iron Ore in Mineral and Grant Counties is found mainly in the Oriskany Sandstone of Devonian age, and in the Clinton Series of the Silurian, the former being principally brown hematite and the latter red hematite. In the Pennsylvanian rocks there are lenticular strata of low-grade carbonate deposits, originating through the replacement of Carboniferous limestones, but without exception these latter are too lean in iron and too scanty in quantity to be considered as having any possible value, although an attempt was once made to use some of these as will be later discussed.

The Oriskany and Clinton ores are confined entirely to the region east of the Allegheny Front, their outcrops being mainly in New Creek, North Fork, Knobly, Cave, and Elkhorn Mountains. The Oriskany ores are lean and lenticular, being usually mere pockets of ocherous or siliceous material and can not be regarded as a valuable mineral resource, although

attempts have been made to work them and they are therefore of both historical and scientific interest.

The Clinton ores consist of the quite persistent and often fairly rich **Fossil Ore Horizon,** coming within a few feet of the top of the series, and the equally persistent but quite siliceous and lean **Iron Sandstone,** lying near the bottom of the series and only a few feet above the White Medina Sandstone. The Fossil Ore Horizon was formerly considered as a fairly continuous sheet of ore but the fact that it is only a surface enrichment of a fossiliferous limestone was pointed out many years ago by Dr. I. C. White[1]. The Iron Sandstone, on the contrary, is not known to decrease perceptibly in ferruginous content with depth and appears to have derived its iron content from some unknown source at a period much more remote than that in which the segregation of the Fossil Ore occurred. It is quite possible the Iron Sandstone, in many cases, is the primary source of the Fossil Ore, since the latter is usually found best developed at the foot of anticlinal mountains where the Iron Sandstone outcrops at a higher level toward the crown of the arch, so that the flow of surface waters from the sandstone is down the slope toward the fossiliferous limestone of younger age. A sufficient amount of investigation has not been made to justify the statement of such a theory as a positive belief but it is quite significant that in both Greenland and Kline Gaps, Grant County, where the Iron Sandstone is raised to a high level on New Creek Mountain, it is abnormally lean in iron while the Fossil Ore Horizon at the base of the mountain is thicker than usual and quite rich in ore. At the same time the Iron Sandstone occurring just above drainage at the northern end of Abrams Ridge, near Keyser, Mineral County, is much richer in iron than at either Greenland or Kline Gap, while the Fossil Ore both east and west of the old Alkire mine at Abrams Ridge can scarcely be found, its horizon having received no drainage from the sandstone outcrop.

The outcrop of the Clinton Iron Ores in Mineral and Grant Counties, respectively, is indicated on Figures 30 and 31.

Previous Development, Iron Ore.

In Mineral County, iron was once made from Oriskany ore at the Vulcan Furnace at the foot of Knobly Mountain 2 miles northeast of Knobly, and from the same ore horizon at the McCarty Furnace on Elliber Run about one mile south-

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[1]I. C. White, Report G7, Second Geological Survey of Pennsylvania, p. 112; 1883.

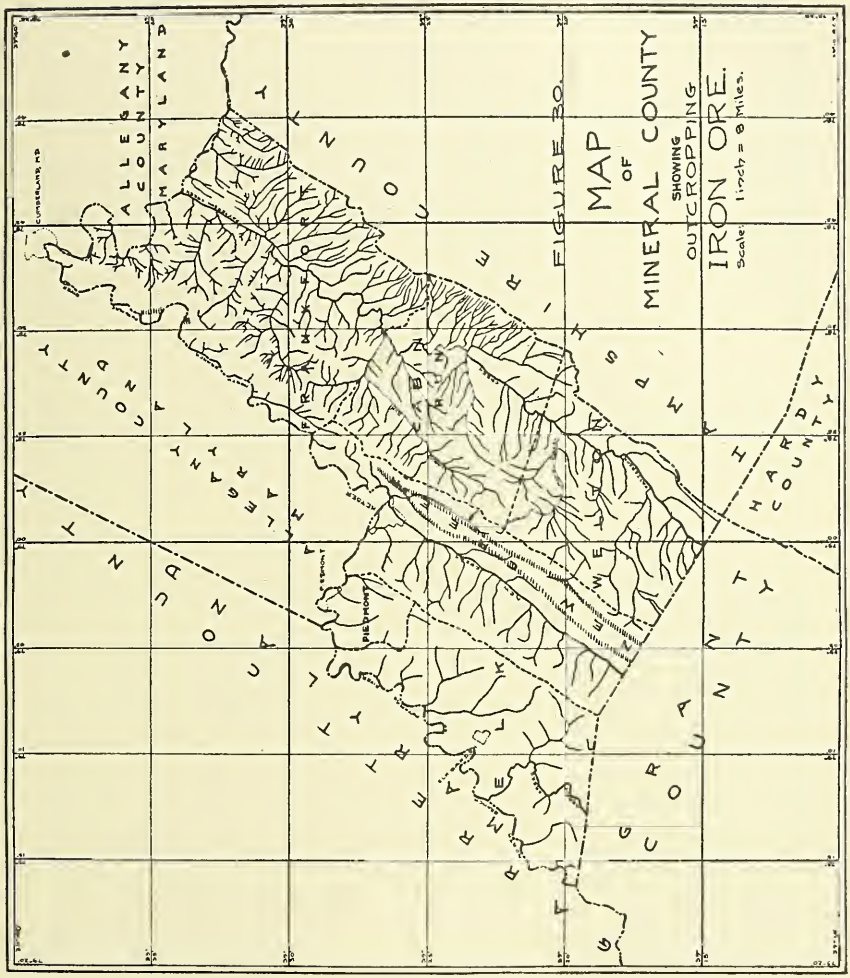
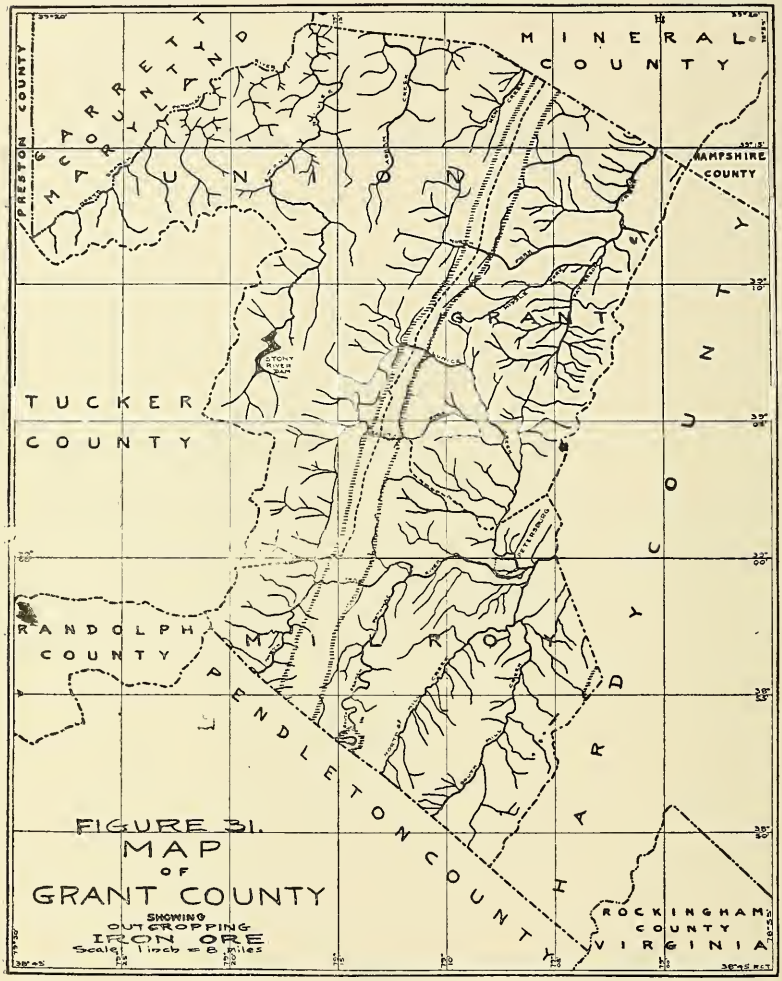


FIGURE 30.
MAP
OF
MINERAL COUNTY
SHOWING
OUTCROPPING
IRON ORE.
Scale 1 inch = 8 Miles.
ALLEGANY COUNTY MARYLAND
GARRETT COUNTY
HARDY COUNTY
PIEDMONT
MINERAL


PRESTON COUNTY
MINERAL COUNTY
HAMPSHIRE COUNTY
GRANT COUNTY
TUCKER COUNTY
RANDOLPH COUNTY
PENDLETON COUNTY
ROCKINGHAM COUNTY VIRGINIA
STONY RIVER
PETERSBURG
FIGURE 31.
MAP
OF
GRANT COUNTY
SHOWING
OUTCROPPING
IRON ORE
Scale, 1 inch = 8 miles

west of Russelldale. In the same county the Iron Sandstone of the Clinton Series was once quarried for ore at the Alkire Mine at the northern end of Abrams Ridge about one mile southeast of Keyser, the raw material having been shipped away for treatment. In the same county some shipments of ore were once made from a pit on the western slope of the Allegheny Front from one of the ferruginous limestones of the Allegheny Series of the Pennsylvanian.

In Grant County, ore from the Fossil Ore Horizon of the Clinton, quarried at the eastern end of Greenland Gap, was once used at the Fanny Furnace located on North Fork of Patterson Creek one-half mile northeast of Falls.

Authentic information on the exact dates when these old furnaces were in blast is not available but it is not known that any of them were in operation after 1860. Such information as is available concerning them will be found on subsequent pages.

Prospects and Exposures, Iron Ore.

Iron Ore Prospects and Exposures, Allegheny Series.

Z. T. Kalbaugh Prospect.—In Mineral County an attempt was once made to mine iron ore from one of the ferruginous limestone horizons of the Allegheny Series of the Pennsylvanian, the locality being on land now owned by Dr. Z. T. Kalbaugh on the north side of Black Ridge, a spur of the Allegheny Front lying between the two branches of Howell Run, 2.2 miles southeast of Shaw, at elevation 2525′ B. This old trench runs N. 25° E., approximately parallel to the Allegheny Front and with the strike of the rocks, its length being about 100 feet and original depth unknown. According to William Kalbaugh the ore was hauled to the mouth of New Creek (Keyser) and shipped down the Potomac in rafts to a destination now unknown, the digging having been abandoned many years ago. At present the trench is almost completely filled up, there being no vestige of the ore in sight nor any outcrop from which a correlation of its horizon might be made. From its position on the mountain, however, it would appear to be one of the Allegheny limestones, possibly the Johnstown or the Vanport, both of these being somewhat ferruginous at various exposures in the Potomac Valley. This old prospect is chiefly interesting as an example of the great demand for iron in the first half of the past century, since this whole spur would not be capable of producing more than a few hundred tons of a very lean carbonate ore.

Iron Ore Prospects and Exposures, Oriskany Sandstone.

The lenticular nature of the Oriskany iron deposits has already been mentioned. These occur at isolated localities, being usually in the form of soft, ocherous material which often leaches from the sandstone and is caught in adjacent absorbent material. Along the eastern base of Knobly Mountain there are localities where this soft ore has plainly filtered from the steeply pitching Oriskany down the mountainside and has lodged in the Marcellus Shale of younger age but lying at a lower level on account of the eastward dip of the rocks.

Western Maryland Railway Exposure.—Along the West Virginia side of the immediate valley of North Branch of Potomac River no ore was observed in the Oriskany Sandstone, although it outcrops at several points. In Allegany County, Maryland, the following exposure was noted in a cut of the Western Maryland Railway 0.7 mile northwest of Patterson Creek Station, the rocks having a dip of 53° southeastward so that the descending succession is toward the northwest:

	Thickness. Feet.	Total. Feet.
1. Shale, dark, Marcellus	-----	-----
2. Sandstone, limy at base, Oriskany	15	15
3. Iron ore, red, siliceous, 5′ to	10	25
4. Limestone, siliceous at top, Helderberg, visible	200	225

At this locality it would appear that the iron content of the Oriskany had filtered downward through the porous sandstone and had been retained in the base of the rock through inability to penetrate the comparatively non-porous limestone. The deposit seemed too lean to be worth sampling.

Vulcan Furnace.—The Vulcan Furnace was situated just east of the base of Knobly Mountain 2 miles northeast of Knobly, Mineral County, being a quarter-stack with eight-foot inside diameter and still in a fair state of preservation. According to W. E. Abe, present owner of the ground on which it is located, this enterprise was started by John Gamber and was run for several years but was finally shut down about 1860. Nothing is now known of his process but it presumably included the use of charcoal fuel and local limestone for fluxing. The ore was obtained at various pits and trenches along the eastern base of Knobly Mountain just west and northwest of the furnace. The material which was evidently used is a sort of breccia composed of sand, chert, and black shale, cemented tightly together and partly impregnated with hematite. At one of the trenches on the land of Mr. Abe

directly west of the furnace the rocks dip 30° southeastward and rise northwestward toward the summit of Knobly Mountain which is crowned by the New Scotland and Shriver Cherts. Large quantities of chert have rolled down the mountain and lodged on the terrace of Marcellus Shale sediments just east of the Oriskany outcrop. It would appear that the iron has been dissolved from the Oriskany and has been absorbed by the impervious Marcellus, portions of the chert fragments and loose Oriskany sand being cemented into the mass. A sample (No. 542R) was collected from this trench, the composition of which is published in the Table of Iron Ore Analyses at the end of this subject (Iron Ore). The analysis shows only 32.17 per cent. of ferric iron, thus giving a yield of 22.50 per cent. of metallic iron.

Russelldale Exposure.—Along the northern end of the Patterson Creek Mountain Anticline just northwest of Russelldale, Mineral County, there are pockets of ore at the contact of the Oriskany with the Helderberg Limestone where Elliber Run of Patterson Creek cuts across this arch, but they appear to be of small extent.

McCarty Furnace.—The McCarty Furnace, located at the present residence of the H. N. Kelley Heirs on the west side of Elliber Run of Patterson Creek, 1.2 miles southwest of Russelldale, Mineral County, has been abandoned and removed, leaving only some of the old debris. Beyond the simple fact that a furnace was once operated here by a man named McCarty no further details or dates are available. Ore for this furnace was principally obtained at three old pits located on the same side of Elliber Run, 0.3 mile northward, and 0.9 mile southwest of Russelldale. Here the segregation of ore appears to be quite the same as at the Vulcan Furnace previously described, except that there is no chert in the breccia. The structural conditions are essentially the same, however, the deposit being at the eastern base of a branch of Patterson Creek Mountain on the slope of which the Oriskany Sandstone outcrops at a steep angle, its dip being eastward toward the ore bed. The ore is found in a matrix of black Marcellus Shale and has apparently filtered down the slope from the Oriskany and has been arrested by the impervious Marcellus where the topography flattens out. A sample (No. 574R) was collected from loose chunks of ore lying about the old pits on the land of the H. N. Kelley Heirs, the composition of which is published in the Table of Iron Ore Analyses at the end of this subject (Iron Ore). The sample shows 35.10 per cent. of ferric iron, making 24.55 per cent. of metallic iron, or slightly more than the Vulcan Furnace.

On the mountain just west of the old McCarty Furnace there is a deposit of soft red ocherous material at the Oriskany outcrop, but it contains only 6.31 per cent. of ferric iron. Although too lean to be classed as an iron ore it is the probable source of the accumulation in the Marcellus beds. It will be later discussed under the subheading of "Ocher."

In Grant County no attempt has been made to use the Oriskany ore and apparently there is none that may ever be worked. On the south end of Patterson Creek Mountain, 1 to 1½ miles northeast of Petersburg, the outcrop of the Oriskany is ferruginous but not sufficiently so to class it as an iron ore. In the public road just north of Kessel, Hardy County, about 1½ miles east of the ridge of Patterson Creek Mountain, there is visible a small deposit of ocherous ore in the top of the Oriskany. The outcrops of the Oriskany throughout Grant County are abundant but there appears to be no possibility of it containing commercial ore.

Iron Ore Prospects and Exposures, Clinton Series.

In the Clinton Series of the two counties there appear to be only two iron-bearing horizons, the **Fossil Ore Horizon** at the top of the series and the **Iron Sandstone** near the base. At other levels there are occasional small ferruginous lenses but they are not consistent and are so insignificant as to require nothing more than a passing remark.

In northern Mineral County the **Fossil Ore Horizon** is inconspicuous, its outcrop being mainly confined to low ground along North Branch of Potomac River east of the Wills Mountain Anticline and being largely covered with recent material. So far as known no attempt has been made to prospect it. In the northwestern edge of Cumberland, Maryland, there is a somewhat extensive trench, starting on the south side of Wills Creek, 1 mile northwest of the mouth of the creek, and extending southwestward up the slope of a round hillock which is now part of the city. This trench is now filled up and there is no visible ore on the dumps so that no intelligent idea may be gained as to its importance. Dr. Swartz[2], however, makes the statement that the "Roberts Iron Ore," which appears to be the same as the Fossil Ore Horizon is about one foot thick and of excellent quality in the vicinity of Cumberland, and that it is well exposed near Roberts Station, which latter is just across the river from Mineral County, and he gives the following analysis quoted

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[2]Chas. K. Swartz, Silurian Volume, Maryland Geological Survey, p. 33; 1923.

from Singewald[3], and attributed to a locality in the Narrows of Wills Creek, east of Wills Mountain, being probably the same trench as mentioned above by the writer:

	Per cent.
Fe	37.37
SiO_2	15.05
Al_2O_3	9.89
CaO	9.09
MgO	0.93
Mn	0.30
S	0.06
P	0.51
Ignition	10.41

Along the eastern base of New Creek Mountain in southern Mineral County the following exposure was noted in the public road at the head of Mill Creek 1.4 miles west of Antioch and 1.3 miles northeast of Ash Flat School, the succession being in descending order:

	Feet.
1. Shale, limy, with thin lenses of limestone, Niagara (1410′ B.)	100
2. Sandstone, with lenses of iron ore and having 1′ 0″ of red hematite at base, Fossil Ore Horizon	10
3. Shale, gray (dip southeast, 20°)	

No sample was taken at this locality, the deposit being thin and of apparently restricted linear extent.

In Grant County there are several good exposures of the Fossil Ore Horizon and at one point it was once mined for furnace use.

Katherine McDonald Prospect.—The Katherine McDonald Prospect is located on North Fork of Patterson Creek 1 mile northwest of Falls and 0.3 mile southeast of the eastern entrance to Greenland Gap, being in a notch made between New Creek and Knobly Mountains by two opposite branches of North Fork. The ore outcrops for a considerable distance along the eastern side of the southern branch and is also reported to be present on the northern prong in a similar topographic position. On the southern branch a long trench was dug along the outcrop and the stratum was followed on its rapid southeastward dip into the base of Knobly Mountain, but the old working fell into disuse more than half a century ago so that it is almost completely filled with debris and no

[3]J. T. Singewald, Jr., Iron Ores of Maryland, Maryland Geological Survey, Volume IX, p. 296; 1911.

record of its presumably shallow depth is available. This ore was hauled by wagon to the Fanny Furnace, located farther down North Fork as will be later mentioned.

In 1903, however, some prospecting was done in this locality by a Mr. Edwards of Chattanooga, Tennessee, and one of these openings, located on the McDonald tract one-eighth mile south of the road which passes up North Fork, shows the following succession in descending order:

				Feet.
1. Shale, sandy, with lenticular, fossiliferous limestone				10
2. Iron Ore	1′	0″	Fossil Ore Horizon.....	9
3. Shale, sandy	4	0		
4. Iron Ore, Red, fossiliferous	4	0		
5. Shale, sandy and ferruginous, to bottom (1450′ B.).....				4

The above drift extends southeastward about 20 feet into the mountain, there being a southeastward dip of 35°. A sample (No. 547R) was collected from No. 4 of section the composition of which is published in the Table of Iron Ore Analyses at the end of this subject (Iron Ore), there being a metallic iron content of 42.55 per cent.

Some further analyses of iron ore in this locality are afforded by Dr. Grimsley[4] in Volume IV of the Survey Reports, in which he quotes from Maury and Guerard (Resources of West Virginia; 1876) and from the United States Census Report of 1880, as follows:

"Mr. Maury gives in 1876 two analyses of the red hematite from near Greenland Gap on Little Mountain, the 7-foot seam (No. 1), and a similar variety from a 13-foot seam on Walker's Ridge in the same neighborhood (No. 2). Both analyses were made by C. E. Dwight, and he says that the 13.733 per cent. referred to alumina in analysis No. 2 includes also the moisture and loss.

	No. 1.	No. 2.
Sesquioxide of iron	75.033	68.750
Binoxide of manganese	0.025	.....
Silica	14.354	15.555
Alumina	7.445	13.733
Magnesia	0.230	.....
Lime	0.521	.....
Phosphoric acid	2.020	1.842
Sulphuric acid	0.240	0.120
Loss, etc.	0.132	.....
	100.000	100.000
Iron	52.52	48.130
Phosphorus	0.880	0.803
Sulphur	0.096	0.048

[4]G. P. Grimsley, Volume IV, West Virginia Geological Survey, pp. 139-141; 1909.

"The following analyses of the fossil ore at Lewis farm mines, and from Wm. Michael farm on Walker's Ridge are given in United States Census Report of 1880:

Natural Ore.		Dried Ore.		Phosphorus Ratio.
Phosphorus.	Metallic Iron.	Phosphorus.	Metallic Iron.	
I. 0.554	43.09	0.559	43.50	1.286
II. 0.487	47.36	0.487	47.36	1.028

"I. Across two beds, ore aggregate thickness 20 inches. Lewis farm.

"II. Across three beds, ore aggregate thickness 6 inches. Michael farm."

From the context in Volume IV it appears that the Lewis farm coincides in part at least with the present McDonald property. There is no ridge known as Little Mountain in that locality but the reference is probably to Knobly Mountain which is small in comparison to the greater height of New Creek Mountain. Walker's Ridge is on the western side of New Creek Mountain where the Clinton ores dip under drainage on the western flank of the Wills Mountain Anticline.

Fanny Furnace.—The Fanny Furnace, which was located along North Fork of Patterson Creek 0.6 mile northeast of Falls on the Babb farm, was abandoned many years ago and its position is now marked only by a heap of rubbish and the remains of an old dam which was built across the creek. Ores from the diggings above described were used in it, Dr. Grimsley being authority for the statement that a good grade of iron was made. No record of the ownership or management of this old plant is available.

Grant McDonald Exposure.—The following exposure was noted in the public road just east of the extreme head of Shell Run of Lunice Creek 2.3 miles northwest of Maysville, the succession being in descending order:

	Feet.
1. Limestone, flaggy and shaly, fossiliferous, Niagara	....
2. Shale, green, sandy	20
3. Iron ore, shaly and lean, ocherous, Fossil Ore Horizon (1850′ B.)	5
4. Shale, sandy (dip southeast, 32°)	100

In the gap at the summit of New Creek Mountain through which the old Morgantown and Baltimore Pack Trail passes, the locality being 0.8 mile southeast of Forest Hill School, an attempt was once made by unknown parties to find ore by sinking a hole in the flat top of the mountain. This pit shows nothing except boulders of the red Iron Sandstone,

since the Fossil Ore Horizon would belong 200 or 300 feet above the topography.

John Trenton Exposure.—At the John Trenton Exposure, which is located along the public road which passes up Lunice Creek from Maysville through the Cosner Gap and which is 1.1 miles northwest of Maysville and just west of the mouth of Shell Run, the Fossil Ore Horizon is well exhibited, as shown by the following section made in descending order:

				Ft.	In.
1. Limestone, shaly, fossiliferous, **Niagara**				....	..
2. **Iron Ore**	2′	8″	**Fossil Ore Horizon** (1430′ B.; dip east, 30°)	10	2
3. Shale, sandy, ferruginous	1	4			
4. **Iron Ore**	0	4			
5. Shale, sandy, ferruginous	2	8			
6. **Iron Ore**	0	5			
7. Shale, sandy	0	9			
8. **Iron Ore**	2	0			
9. Shale, sandy, greenish-brown, with streaks of ore near top				100	0

A sample (No. 557R) was collected from Nos. 2, 4, 6, and 8 of section, the composition of which is published in the Table of Iron Ore Analyses at the end of this subject (Iron Ore), the metallic iron content being 31.71 per cent.

Stanley Rexroad Exposure.—At the Stanley Rexroad Exposure, which is located in the bank and bed of South Fork of Lunice Creek between Kline and Real Gaps and 0.8 mile west of Kline Gap School, the following succession, in descending order, is visible:

				Feet.
1. Limestone shaly, fossiliferous, **Niagara**, visible				50
2. Shale, sandy				10
3. **Iron Ore, fossiliferous**	2′	0″	**Fossil Ore Horizon** (1450′ B.)	8
4. Shale, sandy	4	0		
5. **Iron Ore, fossiliferous**	2	0		
6. Shale, sandy (dip east, 50°)				

A sample (No. 553R) was collected from Nos. 3 and 5 of section, the composition of which is published in the Table of Iron Ore Analyses at the end of this subject (Iron Ore), the metallic iron content being 30.07 per cent.

In the Smokehole Settlement the Fossil Ore Horizon is visible along the axis of the Cave Mountain Anticline at the Shoock School on a short branch of South Branch of Potomac River, at elevation 1500′ B., but there are only thin streaks of low-grade ore bedded in 10 feet of sandy shale.

In the same settlement the Fossil Ore Horizon is again

visible in the public road along South Branch 0.4 mile northeast of Ketterman and just north of the Grant-Pendleton County Line. Here it shows only 5 feet of sandy shale with streaks of iron ore, as recorded in a measurement of the Clinton in the description of that series, page 411.

Adam Ketterman Heirs Prospect.—At the Adam Ketterman Heirs Prospect, located in the edge of Hardy County at the summit of the mountain road which passes from Masonville to Brake and 1.5 miles southeast of the former place, at elevation 2375′ B., a considerable amount of hematite has been exposed, apparently at the Fossil Ore Horizon. The section is not visible at the present time but a sample (No. 566R) collected from the dump shows 50.66 per cent. of metallic iron, as indicated in the Table of Iron Ore Analyses at the end of this subject (Iron Ore).

The **Iron Sandstone,** which constitutes the lower belt of the Clinton Iron Ores, is well exposed in both Mineral and Grant Counties, being an abundant and persistent deposit at nearly all points along its extensive outcrop. Its value as an ore, however, is subject to much doubt, since it has a silica base and the iron content is quite low. It may be regarded as a low-grade ore reserve which should be let alone until such time as the exhaustion of better material or the development of improved blast-furnace practice may make its exploitation feasible.

Alkire Heirs Prospect.—At the Alkire Heirs Prospect, located in northern Mineral County on a branch of Limestone Run of North Branch of Potomac River 1 mile southeast of Keyser and just south of the Keyser-Headsville road, at elevation 915′ B., the Iron Sandstone was once mined, or quarried, for iron ore. According to Dr. White the raw material was shipped to Wheeling for treatment but proved to be too siliceous for successful use. The exposure is on the axis of the Wills Mountain Anticline where stripping is easily possible, there being a dip of about 15° on either limb. The old quarry is 75 feet long by 50 feet wide, the full thickness of the rock, which varies from 5 to 7 feet, being used. A sample (No. 575R) was collected from the face of the ledge, its composition being published in the Table of Iron Ore Analyses at the end of this subject (Iron Ore). The metallic iron content is 36.01 per cent.

From the Alkire prospect southwestward up Limestone Run the Iron Sandstone outcrops along the eastern slope of Abrams Ridge for four miles, there being an abundance of its blocky boulders in the public road. Farther southwest it follows the eastern base of New Creek Mountain for approximately 26 miles through Mineral and Grant Counties, as

previously described in detail, there being many points where it could be quarried if so desired. It is well exposed in the public road 0.8 mile eastward from New Creek village at the point where the Wills Mountain Anticline crosses this highway, being 10 to 15 feet in thickness and apparently quite ferruginous, and for a half mile or more northwest of the anticline it closely follows the same road, the topographic and structural slopes being almost identical.

J. E. Hanlin Exposure.—In Grant County, on the western side of the Wills Mountain Anticline, it is fully visible in the bed and bank of North Fork of Patterson Creek 0.1 mile southeast of Greenland, where it dips westward at an angle of 75° and immediately passes under drainage. Here it has a total thickness of 20 feet, all of it being ferruginous except for streaks of gray shale near the middle, having a combined thickness of 3 feet and leaving 17 feet of iron-bearing material. A sample (No. 548R) was collected at this point on the land of J. E. Hanlin, the composition of which is published in the Table of Iron Ore Analyses at the end of this subject (Iron Ore). The metallic iron content is only 5.58 per cent., however, being much too lean for commercial ore.

Cecil Feaster Exposure.—On South Fork of Lunice Creek just east of Kline Gap and 0.9 mile west of Kline Gap School, Grant County, the Iron Sandstone is completely visible on the land of Cecil Feaster, being 55 feet thick, as detailed in a measurement published under the description of the Clinton Series, page 411. The upper portion of this rock, comprising 40 feet, is a fossiliferous and ferruginous mass, from which a sample (No. 554R) was collected, the composition of which is published in the Table of Iron Ore Analyses at the end of this subject (Iron Ore). The metallic iron content is only 9.82 per cent., however, and too lean for commercial exploitation. At this exposure the dip is 32° eastward.

On North Fork of South Branch of Potomac River at the east end of North Fork Gap and 2½ miles southwest of Corners, Grant County, there are abundant boulders of the Iron Sandstone visible along the public road but the ledge was not noted in place, its outcrop being concealed.

John Self Exposure—In the Smokehole Settlement the Iron Sandstone is plainly visible in a small ravine on the eastern side of South Branch of Potomac River just southeast of the store of John Self and 1 mile northward from the Pendleton County Line. Here it is 60 to 70 feet thick and ferruginous, its base being at elevation 1285′ B., or about 135 feet above river-level. The good exposure is mainly due to a local anticlinal flexure having a dip of 54° on the western, and 30° on its eastern limb.

Ocher.

Small deposits of red ocher are found in both Mineral and Grant Counties. This material is a soft variety of iron ore, having a clay base and being colored red by ferric iron, its use being as a mineral pigment. In the two counties it occurs mainly in the form of lenses within the body of the Oriskany Sandstone where the ferruginous content of the rock has apparently been concentrated in crevices by the leaching effect of circulating water. It also occurs to a much more limited extent in the Helderberg Limestone where its method on concentration appears to be much the same, the main source of the iron being apparently from the Oriskany Sandstone which lies above the limestone. Owing to their infrequent occurrence and small extent these deposits apparently offer little inducement for commercial exploitation, although they could be locally utilized if so desired.

H. N. Kelley Heirs Exposure.—In Mineral County there is an exposure of red ocher on the land of H. N. Kelley Heirs along the abandoned grade of the Twin Mountain and Potomac Railroad on the western side of Elliber Run of Patterson Creek 1.3 miles southwest of Russelldale, at elevation 1315′ B. This old grade skirts the eastern slope of a prong of Patterson Creek Mountain, there being a rapid eastward dip and the Oriskany Sandstone being the outcropping formation. At the point mentioned a cut has exposed a quantity of red ocher of uncertain thickness and extent. A sample (No. 573R) was collected, the composition of which is published in the Table of Iron Ore analyses at the end of this subject (Iron Ore). The ferric iron content is only 6.31 per cent. but ochers with even less iron are now in commercial use. A considerable amount of prospecting would doubtless be necessary to determine whether there is enough material at this exposure to make its use worth while.

Oak Hill School Exposure.—In Grant County there is an exposure of red, ocherous material at the contact of the Marcellus Shale and Oriskany Sandstone at the eastern base of Knobly Mountain where the old Morgantown and Baltimore Pack Trail passes down a branch of Lunice Creek 0.3 mile west of Oak Hill School and 1.7 miles northward from Maysville, at elevation 1615′ B. Here the rocks dip eastward at the rate of 40° which is greater than the slope of the mountain so that the deposit is soon covered by the Marcellus Shale. The probable amount of material at this point could be determined only by a considerable amount of prospecting.

Peacock Cave Exposure.—In the Peacock Cave, which is located in a spur of Cave Mountain in the Smokehole Settle-

ment of Grant County along South Branch of Potomac River, the Helderberg Limestone has been much fissured and broken by deformational stresses, the cracks being made larger by percolating waters. In some of the horizontal cracks there are deposits of soft, colored material, varying from a few inches to two feet or more in thickness. Toward the mouth of the cave these deposits have a yellow color and are largely composed of lime so that they are of a marly nature. An analysis of a sample from this part of the cavern has been published in the Table of Limestone Analyses, page 678, following a previous description.

Farther in the cave, 600 feet from its mouth by actual measure and continuing for an explored distance of 150 feet, some of the horizontal crevices are filled with a soft and sticky ocher, having a rich red color and thicknesses that vary from four inches to one foot or more in some of the larger pockets. A sample (No. 562R) was collected from this ocher, the property being that of the Royal Glen Land and Lumber Company. Its composition is published in the Table of Iron Ore Analyses at the end of this subject (Iron Ore). Its ferric iron content is 10.99 per cent. and its lime oxide only 2.52.

The analysis of this material and its physical appearance indicate that it would make a good mineral pigment but the small amount in sight as well as its almost inaccessible location would probably mean failure for any attempt at commercial exploitation. Its examination was undertaken because of a report that the cave contained a valuable deposit of saltpeter. According to the story, many details of which appear to be well authenticated, a man named Peacock was engaged in the manufacture of gunpowder on a small scale at this locality about the year 1808, his source of material having been the cave which now bears his name. As told by Mrs. Smith, an aged resident of the community and the mother of John Smith who acted as the guide of the writer, Mr. Peacock mixed the material obtained in the cave with hickory wood ashes in a wooden hopper and by pouring water on the mixture obtained a filtrate from which his gunpowder was concentrated.

At a point something more than 600 feet in the cave there is a rude ladder made of poles which gave access to a high shelf where the remains of an old platform may still be seen and where there apparently exists a seam of the red, sticky ocher, although the old ladder is now broken in two and actual examination of the point of mining was found to be impossible. Down in the river valley where the hopper was located, however, there is a large amount of red soil which is quite different from the natural sandy loam. From this

circumstance, as well as from the evidence in the cave, it appears quite certain that Peacock laboriously gathered red ocher in the cave and, carrying it to the foot of the mountain, mixed it with wood ashes in the belief that it contained nitrates. The analysis of sample No. 562R, however, shows only one-tenth of one per cent. of potassium oxide and no potassium nitrate so that the addition of the ocher to the wood ashes could not have appreciably enriched the potash of the wood which was evidently the true source of the explosive material.

In order that no part of the supposed potash of the cave might be overlooked a sample (No. 563R) was collected from the bat excrement which has accumulated in some quantity in the crevices but its analysis shows 41.00 per cent. of silica and an ignition loss of 58.48 per cent., no trace of potash being found.

Summary of Available Iron Ore.

The following table is an estimate of the amount of available iron ore in the Fossil Ore Horizon and the Iron Sandstone, both of which are members of the Clinton Series. No figures are given for the iron content of the Oriskany Sandstone because the localities where segregation has occurred are so few and of such small extent that the possible recovery from this horizon appears to be altogether insignificant. The Fossil Ore Horizon, however, nearly always contains as much as 1 foot of good ore and it frequently has several feet, as indicated in previous sections. In chemical content there is an average of 38.7 per cent. of metallic iron and the satisfactory use of this ore in former years is even more positive evidence of its value. It may therefore be classed as a tangible asset of the two counties, the realization from which will necessarily be deferred until the richer ore bodies of the country will have become scarce.

On the Iron Sandstone the evidence is much less assuring. Its average analysis shows a metallic iron content of only 17.1 per cent. and it has a silica base which is a disadvantage of much importance. The probable outlook for this ore is that attempts will be made to use it in certain localities where future operations in the Fossil Ore Horizon will be installed and where the iron content and quarrying costs are most favorable. Its comparatively great thickness, its continuity, and the fact that it frequently occupies large areas on mountain slopes where the dip of the bed is little more than the dip of the topography so that its recovery is much in the nature of a stripping operation, are factors that will

doubtless cause it to be thoroughly prospected for the richer accumulations. It is therefore included in the estimates because such information about it will ultimately be sought.

In computing the reserves from these two horizons their miles of outcrop have been measured on Maps II and IV and a thickness based on previously published sections has been assumed, the evidence on these two points being reasonably clear. On the subject of mining depth or width, whichever it may be termed, the assumption is much more speculative. In the case of the Fossil Ore Horizon it has already been pointed out that this bed is considered as a limestone replaced by iron at the surface and gradually decreasing in ferric content with depth, this conclusion having been reached by Dr. I. C. White many years ago in his study of the same bed in Pennsylvania where, in many localities, it has actually been mined to a depth where the iron has practically disappeared. If it stood in a vertical position it is quite probable that increasing costs and decreasing iron would cause the abandonment of mining at a depth of not more than 250 feet but its dip on the eastern sides of the anticlines where it is brought to the surface is usually only 20 to 40° and on the western sides, where folding is more abrupt, it varies from 50 to 70°, making a probable average of 45° which in practice will be further reduced by an average descending topographic slope of at least 15° so that the net dip for computing depths to the ore body will not be more than 30°. On the basis of percolation and replacement to a vertical depth of 250 feet the width of the strip of ore that may be mined becomes approximately 500 feet and this figure has been used in making the estimates.

A further factor of some importance is the unit weight of the ore. From the table of analyses on a following page the average of metallic iron in the Fossil Ore Horizon is 38.7 per cent., or roughly 39 per cent. The weight of pure iron is 454 pounds per cubic foot and the weight of the combined sandy and calcareous residue has been assumed as 150 pounds, so that the weight of a cubic foot of this ore, based on percentages of chemical content, becomes approximately 268 pounds, and this figure has been used in computing the tonnage.

In the case of the Iron Sandstone the iron is considered as connate so that its percentage will not decrease with depth and may even slightly increase because there will be no leaching. On the other hand it is apparent that this horizon may be utilized only where the costs are a minimum such as may be had in stripping or other surface methods. This assumption would appear to preclude the recovery of any appreciable amount of the ore but in actual fact its bed often

makes the surface of long mountain slopes, especially on their eastern sides where the dip is more gentle. Such being the case it is believed that the same average width of 500 feet, as used for the Fossil Ore Horizon, will be a conservative figure for the Iron Sandstone and it is accordingly used. By a computation similar to that used for the Fossil Ore Horizon the weight of a cubic foot of Iron Sandstone is found to be approximately 202 pounds and this figure is used.

According to the assumptions and computations just enumerated the available ore from the two horizons in the two counties is given in the table on page 706.

Table of Iron Ore Analyses.

The samples of iron ore taken by the writer in the two counties and analyzed by Mr. Kaplan are assembled in the following table which also includes two samples of ocher. In a few samples the determination of an additional factor is indicated in foot-notes and in such cases this factor is a part of the total as given in the table. The following is a list of the descriptions of the localities where samples were taken:

542R. Oriskany Ore, W. E. Abe, Knobly Mountain, 2 miles northeast of Knobly, Mineral County; described on pages 692-3.

574R. Oriskany Ore, H. N. Kelley Heirs, Elliber Run, 1.2 miles southwest of Russelldale, Mineral County; described on page 693.

547R. Fossil Ore Horizon (Clinton Series), Katherine McDonald, North Fork of Patterson Creek, 1 mile northwest of Falls, Grant County; described on pages 695-6.

557R. Fossil Ore Horizon (Clinton Series), John Trenton, Lunice Creek, 1.1 miles northwest of Maysville, Grant County; described on page 698.

553R. Fossil Ore Horizon (Clinton Series), Stanley Rexroad, South Fork of Lunice Creek between Kline and Real Gaps, 0.8 mile west of Kline Gap School, Grant County; described on page 698.

566R. Fossil Ore Horizon (Clinton Series), Adam Ketterman Heirs, mountain road in edge of Hardy County, 1.5 miles southeast of Masonville; described on page 699.

575R. Iron Sandstone (Clinton Series), Alkire Heirs, Limestone Run, 1 mile southeast of Keyser, Mineral County; described on page 699.

548R. Iron Sandstone (Clinton Series), J. E. Hanlin, North Fork of Patterson Creek 0.1 mile southeast of Greenland, Grant County; described on page 700.

554R. Iron Sandstone (Clinton Series), Cecil Feaster, South Fork of Lunice Creek, just east of Kline Gap and 0.9 mile west of Kline Gap School, Grant County; described on page 700.

573R. Ocher from Oriskany Sandstone, H. N. Kelley Heirs, Elliber Run, 1.3 miles southwest of Russelldale, Mineral County; described on page 701.

562R. Ocher from Helderberg Limestone, Royal Glen Land and Lumber Company in Peacock Cave, Grant County; described on page 702.

Summary of Available Iron Ore, Mineral and Grant Counties.

COUNTIES by Districts.	Fossil Ore Horizon.				Iron Sandstone.			
	Miles of Outcrop.	Thickness Assumed. Feet.	Cubic Feet of Ore.	Short Tons (2000 Lbs.) of Ore.	Miles of Outcrop.	Thickness Assumed. Feet.	Cubic Feet of Ore.	Short Tons (2000 Lbs.) of Ore.
MINERAL:								
Frankfort	1.5	1	3,960,000	530,640	1.4	20	73,920,000	7,465,920
New Creek	27.0	1	85,536,000	11,461,824	24.2	15	958,320,000	96,790,320
Totals, Mineral County	28.5		89,496,000	11,992,464	25.6		1,032,240,000	104,256.240
GRANT:								
Grant	16.5	3	130,680,000	17,511,120	16.0	25	1,058,112,000	106,869,312
Milroy	23.0	3	182,160,000	24,409,440	22.3	30	1,766,160,000	178,382,160
Union	21.5	2	136,224,000	18,254,016	21.5	25	1,419,000,000	143,319,000
Totals, Grant County	61.0		459,064,000	60,174,576	59.8		4,243,272,000	428,570,472
Grand Totals, both Counties	89.5		548,560,000	72,167,040	85.4		5,275,512,000	532,826,712

Table of Iron Ore Analyses.

Sample Number	Geologic Horizon	Silica (SiO_2)	Ferric Iron (Fe_2O_3)	Alumina (Al_2O_3)	Lime (CaO)	Magnesia (MgO)	Titanium (TiO_2)	Phosphoric Acid (P_2O_5)	Loss on Ignition	Total	Metallic Iron
542R	Oriskany	42.95	32.17	12.31	1.20	1.17	.55	.22	8.67	99.24(†)(‡)	22.50
574R	Oriskany	35.75	35.10	22.14	1.70	.....	....	.26	5.66	100.61	24.55
Average	Oriskany	39.35	33.635	17.225	1.45	1.17	.55	.24	7.165	99.925	23.525
547R	Fossil Ore Horizon	5.43	60.84	13.80	7.70	1.80	....	.46	9.66	99.69	42.55
557R	Fossil Ore Horizon	11.30	45.34	15.66	10.20	.....	....	....	18.15	100.65	31.71
553R	Fossil Ore Horizon	11.30	43.00	15.89	5.75	3.39	....	.16	20.20	99.69(§)	30.07
566R	Fossil Ore Horizon	8.85	72.43	3.70	2.46	.....	....	.09	7.41	99.94	50.66
Average	Fossil Ore Horizon	9.22	55.40	13.51	6.53	2.515	.55	.236	13.855	99.99	38.747
575R	Iron Sandstone	38.00	51.48	8.13	1.05	.....	....	.37	1.48	100.51	36.01
548R	Iron Sandstone	64.50	7.98	26.72	.70	.....	....	.05	.52	100.47	5.58
554R	Iron Sandstone	79.14	14.04	5.67	.....	.....	....	.05	1.44	100.34	9.82
Average	Iron Sandstone	60.546	24.50	13.506	.875	.....	....	.156	1.146	100.44	17.136
573R	Ocher	63.36	6.31	20.61	1.70	.....	....	.16	8.30	100.44	.....
562R	Ocher	38.90	10.99	27.31	2.52	.....	....	....	18.36	99.58(*)	.....
Average	Ocher	51.13	8.65	23.96	2.11	.....	....	.16	13.33	100.01	

(†) Manganous Oxide (MnO), trace.
(‡) Sulphur, none.
(§) "The iron in this sample is mostly in the form of the carbonate of iron."
(*) Potassium (K_2O), 0.10; Sodium (Na_2O), 1.40.

PRECIOUS METALS.

General Statement.

A study of the stratigraphic and structural evidence embraced in this Report would doubtless convince the experienced geologist or mining engineer that precious metals, like gold, silver, copper, and lead, will not be found in appreciable quantities in the two counties. Throughout all the mountain regions of West Virginia, however, there exists a wide-spread belief, or at least a hope, that there is an abundance of these materials, and expressions to the effect that the investigator who reports their apparent absence has failed to perform properly his appointed task or has dishonestly suppressed the truth, are not uncommon. In some of the more rugged portions of Mineral and Grant Counties such ideas are given credence, although the belief in the local existence of metals is not as strong as in some other counties and not as much prospecting has been done for them.

The factors which govern the accumulation of precious metals and the almost total absence of some of these essential conditions from West Virginia have already been mentioned by the writer in a previous volume[5]. Mineral and Grant Counties are no exceptions to the general rule. All their rocks are of a sedimentary character, without any trace of igneous or quartzitic intrusions with which these metals are commonly and almost wholly associated. There are no dikes or plugs and the only quartz is that which is contained in the pebbles of the conglomeratic sandstones and which has been derived from the destruction of ancient mountain masses farther east. There were probably mineral lodes in some of these old mountains but in the process of their destruction their ores have been broken up and dissipated so that in the regions where their disintegrated particles finally come to rest there are only traces of their former localized accumulations.

Traces of Ore.

In Welton District, Mineral County, a reported lead prospect was examined on Dry Run of Mill Creek 1.9 miles northwest of Burlington. The locality is between the Bedford Syncline and Evitts Mountain Anticline between which there is a series of minute local flexures. The outcropping rocks appear to be in the basal portion of the Chemung although they may possibly be in the top of the Portage. According

[5] David B. Reger, Tucker County Report, West Virginia Geological Survey, pp. 429-430; 1923.

to Mr. W. A. Liller, of Keyser, under whose guidance the place was found and who had been familiar with it for many years, enough fragments of lead had been taken from it to arouse local interest. Here there is a small cliff of alternating flagstones and shales in the bank of the run and more of the same strata visible in its bed, there being some very thin, quartzitic veinlets between the formerly horizontal layers of rock. In some of these a few incrustations of lead sulphide were found but no nuggets of appreciable size were noted. The occurrence is quite similar to others which have been recorded in Tucker and other counties where the Chemung and Portage rocks have been similarly disturbed and where disappointment has always followed any attempt to exploit them.

In the same county and district a supposed **graphite** prospect was examined on the head of a branch of Patterson Creek 1.9 miles southeast of Burlington, attention having been called to it by H. F. Shank, of Burlington, who served as guide in this instance. The locality is less than one-half mile west of the axis of the Beaver Run Anticline the outcropping formation being the Marcellus Shale of the Devonian. This prospect was reopened but revealed nothing except platy fragments of black shale of which the Marcellus is generally composed.

In the Smokehole Settlement, Milroy District, Grant County, there is a reputed occurrence of **gold ore** in the eastern bank of South Branch of Potomac River 1.1 miles northeast of Ketterman Post-office. An examination of this locality resulted in the finding of some small yellow particles bedded in the White Medina Sandstone, their appearance being that of iron pyrites, as previously explained in the description of the White Medina at this locality, page 418.

In Grant District, Grant County, at Williamsport, on Patterson Creek, there are greenish tints in a large accumulation of marl that appear to be caused by a small amount of **copper** which has undergone some slight concentration in the process of being carried from the original bedded limestone from which the calcareous material forming the marl bed has come. The occurrence is of interest but of no apparent value.

FORESTS.

In Volume V of the State Survey Reports (1911) Mr. A. B. Brooks, former State Forester, has described briefly the forestry of the two counties, pages 200-202 being devoted to Mineral and pages 141-145 to Grant. The description of

present conditions and the lumber mills are now somewhat obsolete but the account of original forests is of much interest.

Original Timber Conditions.

The account of original conditions in Mineral County by Mr. Brooks is as follows:

Original Timber Conditions, Mineral County.

"The timber in this county did not differ materially from that of Grant and other adjacent counties. Hardwoods grew abundantly in the rich valley and cove lands and a mixed growth of hardwoods and softwoods could be found on the hills and mountains. Chestnut oak was very plentiful on low ridges, especially on Knobly Mountain, growing in some places in almost pure stands or mixed with other hardwoods or with pitch, yellow, and scrub pines."

His account of original conditions in Grant County is as follows:

Original Timber Conditions, Grant County.

"On the Allegheny Mountains red spruce and hemlock were the predominant timbers, originally, with a scattered growth of sugar maples, beeches, and other hardwoods. East of this, beginning abruptly along the upper margin of the Allegheny escarpment, the growth was of many varieties of hardwoods, liberally intermixed with the pines that were found throughout that region. White oak and chestnut oak were the most valuable hardwoods, and yellow pine was the leading softwood of the eastern part of the county."

Present Timber Conditions.

In describing present timber conditions the boundaries of the two counties may be conveniently disregarded since all the territory west of the Allegheny Front naturally falls into one group and the land east of that range into another.

West of the Allegheny Front in both counties there is a vast amount of high plateau land from which nearly all of the original timber has been removed and on which no new growth has come. In Mineral County and to a slight extent in Grant these high lands have been made into farms and put under cultivation but in the Stony River Valley the condition is mainly that of a cut-over wilderness so much ravaged by fire that the development of a new forest appears to be remotely distant. Along the valley walls of North Branch of Potomac River and some of its tributary streams there is a flourishing growth of young timber, a considerable percentage of which is of merchantable size. The larger amount of this will probably be needed to serve the mining and railroad industries of the valley.

In the region of both counties east of the Allegheny Front there are some stands of hardwood of considerable value but no large areas of virgin forests. The principal woodlands are along Knobly Mountain, New Creek Mountain, the eastern slope of the Allegheny Front, Patterson Creek Mountain, Elkhorn and South Fork Mountains and in the Smokehole Settlement, including Cave and North Fork Mountains as well as portions of the more immediate valley of South Branch of Potomac River. In the broad belt of comparatively low land lying between New Creek and Patterson Creek Mountains in Mineral County and between Cave and South Fork Mountains in Grant a large amount of the land has been cleared for farming purposes, leaving only scattered woodlots which have been reserved for local use by their owners.

National Forests.

In recent years the United States Government has established the **Monòngahela National Forest**, embracing lands in Tucker, Randolph, Grant, Pendleton and possibly other counties. This reserve takes in those portions of Milroy and Union Districts, Grant County, lying west of North Fork of South Branch of Potomac River and west of Jordan Run which empties into North Fork near Hopeville, as indicated on Map IV. Much of this land has been already cut over so that a new growth of timber will be required.

Forest Protection Service.

On the Monongahela National Forest an efficient patrol system is in effect, paths being cut through the underbrush which are daily traversed by scouts during the dry seasons of spring and fall when fires are most apt to occur. Private areas of woodland in the two counties have been protected in recent years by the Central West Virginia Fire Protective Association, a semiofficial organization, supported in part by State and Government funds but mainly by private assessment based on acreage. A lookout tower is maintained on the Pinnacle, a high point on the Allegheny Front in Mineral County 7 miles southwest of Keyser.

Lumber Mills.

There are no large lumber mills in either county. The Babcock Lumber and Boom Company, which operates a mill at Davis, Tucker County, has a timber railroad into the Stony River Valley of Grant County where timber is secured and this line has been projected down the steep eastern slope

of the Allegheny Front into the more abundant supply of that locality. The West Virginia Pulp and Paper Company operates a large mill at Luke, Maryland, opposite Piedmont and handles a considerable amount of pulp wood from both Mineral and Grant Counties. At Wallman, Maryland, which is 1½ miles south of the mouth of Stony River, A. G. Miller and Company have a small mill, the logs being mainly hauled by narrow-gauge railroad from Grant County.

There are numerous small portable sawmills scattered throughout the two counties serving local needs, and in the region east of the Allegheny Front an appreciable amount of timber is cut at permanent water-wheel mills in some of the villages and towns where conditions are favorable to this method of securing power.

CHAPTER XX.

CLAY, BUILDING STONE, AND ROAD MATERIAL.

CLAYS AND CLAY INDUSTRY.

Present Development.

Although having a large amount of clay and shale suitable for the manufacture of brick and other clay products these materials have been only slightly exploited in Mineral and Grant Counties. There is one brick plant at Piedmont, Mineral County, and another at Petersburg, Grant County. The city of Keyser has none.

Potomac Fire Brick Company.—The Potomac Fire Brick Company, which has a plant located along the Baltimore and Ohio Railroad on the south side of North Branch of Potomac River three-fourths of a mile southeast of Piedmont, was first established about 1900 under the name of Piedmont Mercantile and Development Company. Later the concern was successively known as the Piedmont Brick and Coal Company and the Piedmont Fire Brick Company, but in August, 1911, it was reorganized under its present title. According to W. F. Caldwell, Manager, the plant manufactures fire brick and fire clay dust, the latter being ground for mortar purposes. The bricks are used in the iron and steel trade, for lime-kilns, boiler settings, and other general refractory purposes, there being an annual output of 1,600,000 bricks. The equipment includes 3 circular, or beehive, down-draft kilns, a crushing or dry pan, a wet pan, a brick machine with semiautomatic cutter, a steam power repress and a hand repress, together with a five-tunnel drier. Coal fuel is employed, both for the kilns and the drier, and the burning process for each batch of bricks requires 6 days. There are 27 men employed in the clay mine and the plant, three-fourths of whom are classed as skilled labor.

Clay is obtained from the Mount Savage Fire Clay horizon of the Pottsville Series, its outcrop being on the mountain

south of the plant and 240 feet above it in vertical measure. It is mined by a drift entry and carried down to the plant by a gravity plane. A section measured in this mine and an analysis of the clay have been published under the description of the Mount Savage Fire Clay, pages 258-9. Valuable tests of this clay have also been made by the Maryland Geological Survey, the results being published in its Volume XI, pages 472-474 (1922), immediately followed by similar tests on the Faraday property adjoining that of the Potomac company.

N. M. Hatch Brick Plant.—In the fall of 1921 a small brick plant was put in operation by N. M. Hatch, of Philadelphia, Pa., in the northern edge of Petersburg, Grant County, being designed to utilize local terrace clay to make bricks for the completion of an addition to the combined high and grade school building at that point. The equipment included a Lancaster Iron Works Soft Mud Machine with a capacity of 4,000 bricks per hour, run by a 22-H. P. gasoline engine, 2 mixing vats and 2 temporary up-draft kilns using wood for fuel. Before burning the bricks were dried by laying them on boards in the sun where they remained for two days. According to Allen Hatch, Foreman, the number of men employed varied from 8 to 20.

Clay for this operation was obtained from terrace material at the site of the plant, the supply being abundant. This clay is yellowish in color, molds readily and burns to a dull red in the kiln. A sample (No. 559R) was collected at the plant on the property of the Petersburg School Board, its composition being as follows, according to Kaplan:

	Per cent.
Silica (SiO_2)	83.41
Ferric Iron (Fe_2O_3)	3.19
Alumina (Al_2O_3)	7.26
Lime (CaO)	trace
Magnesia (MgO)	0.65
Potassium (K_2O)	0.81
Sodium (Na_2O)	0.82
Phosphoric Acid (P_2O_5)	trace
Loss on ignition	3.56
Total	99.70

"This clay fuses at ..... 2750° F.
"This determination was carried out in a reducing atmosphere and therefore gives the lowest temperature at which the clay will fuse."

Available Clay and Shale.

Transported Clay.

Along the valley of North Branch of Potomac River, Mineral County, all the way from Keyser to the Hampshire

County Line there are extensive deposits of river clay, many of which contain material that would be suitable for making brick or drainage tile. In the valley of South Branch of Potomac River, Grant County, from Royal Glen Mill eastward to the Hardy County Line there are similar deposits. These clays are not suitable for the manufacture of paving brick or fire brick but they can be used for common building brick and drainage tile. Their advantage lies in their abundance and the low cost of quarrying. Their principal disadvantage is the variability in chemical or physical quality from place to place, so that many trials are often necessary before a proper mixture can be made.

Residual Clay.

Residual clay, which is derived from weathered rocks and shales and still remains at its original location, is not of sufficient importance in Mineral and Grant to be classed as a building clay material, most of it having washed down the mountainsides to the river and creek valleys below. Whatever of these deposits still remains in place should rather be classed as soil, more suitable for agricultural than for other purposes.

Stratified Shales.

Stratified shales, composed principally of silica and alumina, with a variable content of ferric iron and other minor substances, and having the necessary plasticity for molding into brick or tile shapes, occur in great abundance in both Mineral and Grant Counties. In the region west of the Allegheny Front there is an enormous quantity of red shale in the Conemaugh Series of the Pennsylvanian, as indicated in the measured sections of Chapter V and as described in detail in Chapter VII. In the Allegheny and Pottsville Series of the same region there are no red shales but there are plastic and flinty clays in a much more limited quantity. These latter clays can be used for building or paving brick, and in some cases for refractory material, their presence being indicated in the measured sections of Chapter V and described in detail in Chapters VIII and IX.

In the region east of the Allegheny Front there are vast quantities of red shale in the Mauch Chunk and Catskill Series, both of which outcrop in an unbroken line entirely across both counties along the eastern face of the Allegheny Front. These are described in Chapters X and XI, respectively. They could be used for building brick if desired. In the same region there are sandy shales in the Chemung and

Portage of the Devonian, described in Chapter XI, which at selected localities would make good building brick. In the same region the sandy and aluminous shales of the Hamilton and Marcellus Series, described in Chapter XII, should make excellent building brick. In the same region there are red shales in the Bloomsburg, Clinton, and Red Medina, described in Chapter XIV, and these also could be made into building brick. There is a plant now in operation at Cumberland, Maryland, which makes brick from the Clinton Shales.

From Maps II and IV it is apparent that one or more of the above formations will be found outcropping at almost any community in either county so that there is apparently no good reason why building brick should be imported at high cost from distant plants.

Fire Clay.

The fire clay horizons of the two counties are limited to the regions west of the Allegheny Front where their occurrence is mainly in the Allegheny and Pottsville Series, there being none of much value in the Monongahela or Conemaugh. These have been described under their respective titles in Chapters VIII and IX, where their occurrence may be studied.

BUILDING STONE.

Quarries.

In Chapters VI to XV, inclusive, dealing with the stratigraphy of the rocks, the sandstone quarries of the two counties have been described, and in Chapter XVIII, devoted to limestone, the limestone quarries have been noted. Reference to any of these quarries may be had by consulting the Index at the end of this Report where these items are listed under "Sandstone Quarries" and "Limestone Quarries," respectively, making further recapitulation unnecessary.

Available Stone.

The sandstones of the two counties, as described in Part II of this Report, vary from flaggy and shaly beds that are not sufficiently durable to be used as building stone to great massive ledges, 50 to 300 feet in thickness, that will split into any desired size. In the Monongahela Series there is one coarse gray sandstone (Sewickley) of limited extent. In the Conemaugh there are many, most of them being massive, micaceous, and gray on fresh fracture but sometimes weathering to brown. In the Allegheny and Pottsville they are uniformly gray and highly siliceous, changing in color but little

after long exposure, and often conglomeratic, the included matter consisting of white quartz pebbles. In the Mauch Chunk and Catskill they are highly micaceous, usually flaggy and shaly so that they are not generally suitable for building stone. In the Pocono there are some massive quartzitic ledges from which large building blocks could be obtained. In the Chemung and Portage they are flaggy, and in the Genesee, Hamilton, and Marcellus none are found. The Oriskany is mostly composed of massive sandstone which splits easily but is often too soft for general use. In the Bloomsburg there is a sandstone which is frequently close grained and very hard and should be quite durable. In the Clinton the Iron Sandstone is massive, has a beautiful red color, and is hard enough that it might be called everlasting. Its principal drawback as a building stone lies in its excess of iron which makes its weight more than 200 pounds per cubic foot. In spite of this fact it is believed that it is well worth serious attention, since any structure built from it should have an exceedingly pleasing appearance. The White Medina is an immense quartzite from which blocks of any desired size could be split and it is durable enough to last literally thousands of years but for that very reason it would be difficult to quarry and fabricate into structures. Both the Red and Gray Medina are shaly and flaggy and have little to commend them as building stones.

There are several limestones of almost unlimited extent in both counties and some of them have been used in construction work about the city of Keyser but they have little in their favor. Most of them are hard and campact with an irregular fracture which makes them difficult to quarry and fashion into building blocks. The Greenbrier is of the same geologic period as the much favored limestone of Indiana but it is not oolitic and therefore has a totally different texture. The latter statement is true of the Helderberg, Bossardville, and Rondout, while the Niagara is flaggy and shaly.

On a following page under the subject of "Road Material" will be found a table indicating the principal sandstone beds worthy of attention from a building standpoint, together with the necessary references to their detailed descriptions.

ROAD MATERIAL.

River and Creek Gravel.

Attention has been called in many previous Reports of the Survey to the fact that most of the rivers and creeks of the State contain an abundant supply of gravel, which,

being the more resistant portions of the rocks from which they came, afford good and cheap material for improving roads. This is particularly true in the Chemung and Portage Series, as the thin-bedded sandstones from which they are derived are extremely hard and compact. This gravel can be used to advantage in the improvement of muddy sections of secondary roads where a hard surface may be too expensive and it may also be used as the aggregate for concrete paving and structures.

Chert.

Under the description of the Shriver Chert, pages 337-8, the use of this material for improving roads in both Mineral and Grant Counties has already been noted. This chert is much like blast-furnace slag in its nature and appearance, being porous and inclined to disintegrate into small angular fragments which may often be quarried with ease and trucked to a desired locality. When placed on the road it makes a sort of macadam which soon cements because of the included content of lime and becomes a good tractive surface in a short time. Being a part of the Oriskany Sandstone, which is marked on Maps II and IV, this chert horizon may be easily located and followed.

Sand.

Sand, which is another essential material needed in road building, both in masonry construction and in concrete, is found generally along the rivers and creeks of the two counties. On the North Branch of Potomac River it is derived in great abundance from the coarse sandstones of the Allegheny and Pottsville Series. In the South Branch Valley the sand has the appearance of being more silty on account of the great amount of Devonian shale which mixes with it.

Limestone.

The limestones of the two counties are doubtless their most valuable road building material. The Greenbrier, Helderberg, Bossardville, and Rondout are usually quite hard and durable and their outcrop is so extensive that they may be trucked with ease to almost any point in the region east of the Allegheny Front. They are suitable for macadam and have been so used and they are also well adapted for aggregate in concrete.

Brick Material.

As stated on a previous page, under the heading of "Stratified Shales," there is an abundance of material that can be made into brick, some of which would probably be durable enough for road surfacing provided a subgrade of concrete be provided to take up the shock of traffic. The fire clays of the Allegheny and Pottsville Series should make an altogether acceptable paving brick.

Stone for Masonry, Macadam, and Concrete.

As stated on pages 717-718, under the subject of "Building Stone," there are many sandstone ledges in the two counties that can be used for general masonry construction, as well as for concrete aggregate if limestone or gravel is not locally available. Sandstone is not ideal for macadam but in the region west of the Allegheny Front some of the more resistant ledges like the Lower Freeport, East Lynn, Homewood, and Upper Connoquenessing might be employed to local advantage because of low first cost. In the region east of the Allegheny Front there is such an abundance of limestone that its use to the exclusion of most other materials would appear desirable.

The following table gives a list of the principal sandstones that would prove suitable for quarrying, together with references to the pages on which they have been described, those printed in full-faced type having already been used in masonry construction in the two counties:

Table of Sandstones Available for Masonry Construction.

Name of Sandstone.	Geological Series.	Approximate Thickness. Feet.	Pages on which Described.
Sewickley	Monongahela	30 to 40	198-9
Connellsville	Conemaugh	10 to 20	211
Lower Connellsville	Conemaugh	25 to 50	213
Morgantown	Conemaugh	20 to 30	215
Upper Grafton	Conemaugh	10 to 30	217-18
Grafton	Conemaugh	20 to 30	219-20
Saltsburg	Conemaugh	20 to 40	222-3
Buffalo	Conemaugh	35 to 40	226-7
Upper Mahoning	Conemaugh	10 to 40	229
Lower Mahoning	Conemaugh	25 to 30	231
Upper Freeport	Allegheny	15 to 20	239-40
Lower Freeport	Allegheny	25 to 40	241-2
East Lynn	Allegheny	25 to 30	244-5
Homewood	Pottsville	50 to 80	255-6
Upper Connoquenessing	Pottsville	75 to 140	262-3
Lower Connoquenessing	Pottsville	20 to 40	264-5
Guyandot	Pottsville	10 to 15	266
Sharon	Pottsville	15 to 30	269
Ridgeley	Oriskany	75 to 150	337
Williamsport	Bloomsburg	5 to 50	396-8
Iron Sandstone	Clinton	5 to 50	412-13
White Medina	White Medina	200 to 300	414-18

In addition to the sandstones listed in the above table some of the beds of the Pocono are massive and durable and some of the Chemung and Portage flagstones locally coalesce into more massive deposits that might be of some local value.

PART IV.

Paleontology.

CHAPTER XXI.

NOTES ON THE PALEONTOLOGY OF MINERAL AND GRANT COUNTIES.

GENERAL STATEMENT.

In Mineral and Grant Counties the rocks are generally rich in marine invertebrate fossils, there being certain groups in which few or perhaps none are found. When the writer was assigned these two counties for study early in the field season of 1921 the Survey was entirely without the services of a paleontologist so that it did not appear as though identifications could be obtained even if collections were made. In spite of this fact it seemed neither prudent nor logical to neglect entirely this altogether important aid in the correlation of the rocks and in the interpretation of the sedimentary record, especially since there were known to be serious errors of long standing in the Coal Measures west of the Allegheny Front and since the Devonian and Silurian of the region east of this mountain occupied a highly strategic location from which their ultimate study in a southwestward direction across the State must advance.

Such being the case certain small collections were made in the fossiliferous zones of the Conemaugh Series of the Pennsylvanian for comparison with other regions farther west. Although very limited in their extent these collections serve the purpose for which they were made, the same being to establish beyond doubt the presence of the three principal

fossiliferous zones of this series in the Potomac coal region. Of these three zones the Ames and Brush Creek had already been recognized but the Pine Creek had never been found until the writer dug it out at Piedmont in the early spring of 1921, although its presence had been erroneously reported between the two Bakerstown Coals instead of below them both as is shown to be the case in the Piedmont Section, page 155. It is reasonably well known that the identification of a bag of fossils from any particular locality in the Conemaugh Series does not in itself do much toward advancing the correlation of the coals or other rocks, since almost any species found is known to range into the two other faunal zones. There are certain easily recognized stratigraphic and lithologic associations, however, which individualize the three principal fossiliferous stages so that their identification becomes positive when these associations are clearly established, as has now been done, the Ames and Brush Creek of the Potomac region having been so recognized and determined by the Survey of Maryland and the Pine Creek by that of West Virginia. Such being the case more abundant collections from these three zones would be interesting but would probably show no further controlling factors in correlation.

In the Mississippian no collections were made because it was believed, for reasons previously stated in this Report, that no present deductions could be made from fossil lists in the area under study, although the record of their presence would be of undoubted value after criteria have been established for the subdivisions of this period.

In the older rocks, Devonian, Silurian, and Ordovician, scattered collections, a few of which consisted of only a single specimen of unusual interest and none of which could be regarded as complete, were made by the writer in the two counties.

These altogether scanty and incomplete collections were finally turned over to Dr. Tilton for identification after his retention by the Survey, the handicap as to conclusions so placed upon him being too obvious for further remark. His reports on them will be found in their proper places in the following pages.

In the summer of 1922 much more abundant and complete collections were made in the Devonian, Silurian, and Ordovician Rocks by Professor Earl R. Scheffel of the Geological Department of the West Virginia University and Mr. Paul H. Price. These collections were examined by Dr. Prouty who had become a consulting member of the Survey Staff. The conclusions reached by Dr. Prouty are in the main harmonious with those of Dr. Tilton and the deductions of both

agree so closely with the almost purely lithologic work of the writer that few changes were found necessary in the areal map of the two counties which had already been prepared before the fossils were studied. An important exception, however, was in the geology of North Fork Gap where the identifications of both paleontologists, independently made, fixed the age of the Martinsburg Shale member there exposed.

In all the collections made by Prof. Scheffel and Mr. Price the descriptions of localities and faunal zones to be studied were furnished in advance by the writer and after the return of the collectors from the field a further careful check was made to determine whether any change should be made in the final published descriptions. After all obvious corrections had been made, together with references to the measured sections of the writer the combined data were submitted to Dr. Prouty for use in his interpretation of the fauna. These descriptions and references are published along with his lists so as to give full information. In spite of all the precautions observed there are doubtless instances in which contact lines have been crossed, and in nearly every case the refinement of method that could be observed when stratigraphic measurement and fossil collecting are carried on at the same time has been necessarily lost.

In this Chapter there is also reported a most interesting occurrence of amphibian reptilian tracks occurring on the Maryland side of North Branch of Potomac River, their personal inspection and study by Dr. R. S. Lull of Yale University being reported by himself in a following section.

No attempt has been made to study any of the fresh-water fauna that presumably exists in the Pennsylvanian and possibly Mississippian of the two counties, this problem being left for some future investigator.

The flora of the two counties has not been studied by the Survey. There is an abundance of fossil plants in the Pennsylvanian and a more restricted assemblage in the Mississippian, the examination and classification of which by a competent authority would be of much interest and value. In the older rocks the plant life preserved was much less abundant and appears to be of less importance when compared to the more profuse marine life.

PENNSYLVANIAN FOSSILS.

In the Pennsylvanian Rocks of the two counties marine invertebrate fossils were observed only in the Conemaugh Series. In the Monongahela Series no marine fossils have been recognized in West Virginia nor in any other region, so far as known, where this formation occurs. Invertebrate

fossils of fresh-water origin are known to occur in some of the Monongahela limestones in other counties of the State. In the Allegheny Series marine invertebrate fossils have been noted in one or two zones in other localities but their presence was not observed in Mineral and Grant Counties. A most interesting discovery of vertebrate reptilian tracks has been made in this series in Maryland just across the Potomac River from Mineral County, as will be later detailed. The Pottsville Series contains marine invertebrate fossils in many counties of the State but they were not observed in Mineral and Grant Counties, although one small collection was made on the Maryland side of the Potomac River. It is believed, however, that a more patient search might reveal them in restricted numbers.

MARINE INVERTEBRATE FOSSILS, CONEMAUGH SERIES.

In the Conemaugh Series, a General Section of which is published on pages 203-5, followed by detailed descriptions, three marine zones were observed, these being the **Ames Shale and Limestone,** the **Pine Creek Limestone,** and the **Brush Creek Shale and Limestone,** in descending order.

In the **Ames Shale and Limestone,** which in some previous County Reports has been subdivided into an **Upper Ames Limestone, Lower Ames Limestone,** and an intermediate **Ames Shale,** all of which are fossiliferous, two fragmentary collections were made by the writer at different times along the coal incline of the Deep Run Big Vein Coal Company on the eastern side of Deep Run of North Branch of Potomac River at elevation 1730' B., 0.3 mile northeast of Nethken, Mineral County. These collections were examined and separately described by Dr. John L. Tilton as follows:

"A few fragments of stone weathered brown and, in their present condition, without lime, were obtained on Deep Run of Potomac River northeast of Nethken, Mineral County, West Virginia. From these were obtained six fragments that from their striae, concentric lines, and lack of spines seem to be parts of **Orthothetes (Derbya) crassus** Meek and Hayden, one that seems to be a portion of **Composita subtilita** Hall, five of **Deltopecten (Limipecten) occidentalis** Shumard, and a single portion that appears to be a distorted internal cast of **Aviculopecten sp. a** Girty.

"While these three species are reported from horizons lower than the Ames (Pine Creek and Brush Creek), it is to be noted that none of them are reported from the Lower Ames. If, then, the small fragments are correctly classified, the stratum at Nethken is Upper Ames, not Lower Ames."

"A single rather large specimen (14" x 4" x 3") from Deep Run, northeast of Nethken, Mineral County, West Virginia, was a very resistant cherty stone thought to be Ames Limestone. It is cemented with both iron and quartz. Some of the chert is black, some of it brownish, and some of it gray. Some of the chert is angular, and

some of it regular in outline, evidently of fossils. The outside of the stone was weathered to a brown siliceous mass full of fossils. The top and bottom portions of the interior were also full of fossils, and the remainder had fossils scattered here and there. The stone when broken to pieces yielded the following:

"**Orthothetes (Derbya) crassus** Meek and Hayden. Seven impressions of exterior and casts of interior were exposed as the dense rock was broken open.

"**Productus cora** d'Orbigny. The shape of the dorsal valve with the small striations that belong to this species was found in one specimen. Two other impressions of small portions of shells are also referred to this species, one of them accompanying **Aviculopecten sp. a** Girty and **Deltopecten occidentalis** Shumard.

"**Productus nebrascensis** Owen. A single specimen of the ventral shell was obtained, and a single specimen of the dorsal valve, both with marks of numerous spines.

"**Aviculopecten sp. a** Girty. There are five specimens that appear to be interior casts of an Aviculopecten with double ribs between interspaces that equal in width that occupied by the double ribs. They correspond most nearly to species a, as described by Girty in 'The Gaudalupian Fauna,' Professional Paper 58, United States Geological Survey, page 436. Three of these are somewhat distorted casts of the interior with exterior marks appearing in reverse form.

"**Aviculopecten parvulus** Hall and White. A single fairly good specimen.

"**Deltopecten (Limipecten) occidentalis** Shumard. Six specimens have impressions of the ribs, three of which specimens have also portions of the wings present, sufficient for identification of their form.

"**Edmondia aspinwallensis** Meek. A bivalve 0.5 inch long, 0.35 inch high, with curvature of 0.1 inch, umbos curved in, not prominent, located 0.13 inch from anterior end, shell smooth, preserved as a cast or replacement in black chert, seems sufficient for the identification of this shell as a cast of the interior of the above-named species.

"**Dentalium** (?). An elongated smooth surface with oblique lines of growth seems to belong to Dentalium. The specimen lacks longitudinal ribs.

"**Euomphalus catilloides** Conrad. A single excellent impression of this shell gives the characteristics of the above-named species.

"**Euphemus carbonarius** Cox (?). Only a portion of a whorl is present, but that portion conforms in curvature to that of Euphemus rather than Bellerophon. The specific characteristics are not preserved, but carbonarius with question mark is selected, as that species is one that has been found in Monongalia County and the description seems to apply here.

"**Isochilina** (sp. ?) Jones. Two portions of dark chert are suboval in outline, 5.4 mm. long, 3.3 mm. high, with curvature of about 6 mm., surface smooth and unmarked. While it is possible that this shape is due to physical conditions only, it seems more probable that the shape is determined by organic cause. This view is strengthened by the fact that **Edmondia aspinwallensis** Meek is also clearly reproduced in black chert and **Euomphalus catilloides** Conrad is preserved in a yellowish-gray chert. It is further strengthened by the presence of two impressions of the same shape in a more weathered portion of the rock. Considered as an ostracod it is classed as one of the **Isochilina** Jones, no species being given in the literature at hand.

"The range of species is as follows, as given in the West Virginia Geological Survey Report on Marion, Monongalia, and Taylor Counties, 1913, pages 291-294; and in later Reports:

"Range of Recognized Species, Ames Limestone.

Species.	Upper Ames.	Ames Shale.	Lower Ames.	Pine Creek.	Brush Creek.	Kanawha Group.
Orthothetes (Derbya) crassus Meek and Hayden	*	*		*	*	*
Composita subilita Hall	*			*	*	*
Productus cora d'Orbigny	*	*		*	*	*
Productus nebrascensis Owen	*	*		*	*	
Aviculopecten sp. a Girty	(*)					
Aviculopecten parvulus Hall and Whitf.	(*)					
Deltopecten (Limipecten) occidentalis Shumard	*				*	
Dentalium (sp. ?)	(*)				?	
Edmondia aspinwallensis Meek	(*)	*				
Euomphalus catilloides Conrad	(*)	*		*		
Euphemus carbonarius Cox ?	(*)	*		*		
Ischilina (sp. ?) Jones	(*)					

(*) First West Virginia record.

"From the above record it appears that the outcrop from which the specimens came is an outcrop of the Upper Ames, not an outcrop of the Lower Ames."

In the **Pine Creek Limestone** one small collection was made by the writer in the public road which ascends from Piedmont, Mineral County, southwestward toward the Allegheny Front, the location being one mile southwest of Piedmont at elevation 1434′ B., and another just south of the same road 0.8 mile southwest of Piedmont and directly opposite the pulp-mill which is at Luke, the elevation of this locality being 1397′ B. Later a much more complete collection from this latter locality was made by Prof. Scheffel, Paul H. Price, and the writer. The description of the fossils from the two localities by Dr. Tilton is as follows:

"A few fragments were obtained from each of these two places. The material, which is of the same character from the two places, is possibly a limestone from which the lime has been completely weathered out, leaving a sandy material cemented by hematite and clay. The only indication that it may have been a limestone is in the presence of imprints of fragments of shells. It now has the appearance of a sandstone or of an arenaceous shale in which the grains are cemented together by iron. The four fragments of a fossil from one mile southwest of Piedmont possess the striations of **Orthothetes (Derbya) robustus** Hall, and one fragment has a part of the shell near the hinge line and faint evidence of a septum near a crumpled and elevated beak. There is no evidence of alae, which is against reference to Aviculopecten (and Deltopecten), which have the same style of dichotomous striation. The size of the shell, at least forty millimeters wide, forbids reference to Orthothetes (Derbya) crassus Meek and Hayden. These facts refer it to **Orthothetes (Derbya) robustus Hall,**

a species not before reported from the Pine Creek, but it is reported from the lower coal measures of New York and of Illinois, from the Ames of Ohio, and from the upper coal measures farther west.

"Four fragments from 0.8 mile southwest of Piedmont, while not so good as the fragments from one mile southwest of Piedmont, are evidently of the same species. A fifth fragment 30 mm. wide and 20 mm. long, so far as preserved, has interstitial arrangement of striation, averaging one millimeter apart, with spaces wider than the slightly rounded striations, with no distinct evidence of spines. This shell seems to be a portion of a **Productus**, and the fineness of the striation and the lack of distinct spines favor **P. cora** d'Orbigny in preference to **P. semireticulatus** Martin, a shell which is also found throughout the Coal Measures.

"Fossils from Pine Creek Shale (Limestone) situated 0.8 mile southwest of Piedmont, Mineral County, West Virginia; collected by Reger, Scheffel, and P. H. Price, July 15, 1922:

"The shale is dark, argillaceous, non-calcareous, concretionary, stained with iron and containing minute plates of mica. There are places where it has a dark steely appearance.

"The fragments that are referred to **Aviculopecten** and **Edmondia** are not sufficiently complete to warrant an assignment to species. While the genera have not been reported from the Pine Creek of West Virginia they are reported from this horizon in the Ohio report on the Conemaugh. **Lingula umbonata** Cox is reported from both the Brush Creek and the Pine Creek. **Orbiculoidea convexa** Shumard is reported from the Pine Creek both in West Virginia and in Ohio. The one specimen here at hand is very large, measuring 0.8 inch in length and 0.7 inch in breadth. Large individuals as well as small ones have been recognized elsewhere in the Pine Creek, but none of this species is reported from either the Ames or the Brush Creek either in this State or in Ohio.

"The few fossils found thus confirm the reported field relations that the shale is Pine Creek.

"Range of Recognized Species, Pine Creek Limestone.

Species.	Brush Creek.	Pine Creek.	Ames.
Lingula umbonata Cox, six specimens	*	*	
Orbiculoidea convexa Shumard, one specimen		*	
Aviculopecten (six fragments)	*	*	*
Edmondia (seven fragments)	*	*	*
Productus cora d'Orbigny	*	*	*
Orthothetes (Derbya) robustus Hall			*

In the **Brush Creek Shale and Limestone** three small collections were made. The first is at a sharp turn of the mountain road 0.9 mile southwest of Piedmont, Mineral County, at elevation 1365′ B., as indicated in the Piedmont Section, page 155. The second is in Allegany County, Maryland, on the hill north of North Branch of Potomac River, one-half mile west of Westernport and 0.1 mile northwest of the wagon

mine of Roy Friday, the elevation being 1182′ B. The third is in Garrett County, Maryland, on the Potomac River hill about one-half mile north of Hubbard and 0.2 mile west of the mine of the Hubbard Coal Mining Company, the elevation being 2315′ B. The following is Dr. Tilton's report on these three collections:

"A handful of black argillaceous shale was collected on the public road nine-tenths of a mile southwest of Piedmont, Mineral County, West Virginia. This shale is very iridescent as the laminae are split apart. It contains flattish concretions, that are not uniform in size or shape, and do not have characteristics of fossils. The shale has yielded the following:

"**Plant remains.** There are a few indistinct impressions of narrow leaves with no detail preserved.

"**Lingula carbonaria** Shumard. The fragments are imperfect but apparently belong to this species.

"**Cardiomorpha missouriensis** Shumard ? This shell is nine millimeters long, five high, and four wide; greatest width about a third of length from anterior end, both valves being present. The beaks are close to the anterior end, a distinct lunule evidently beneath them in a triangular anterior end, beneath which the margin curves quickly to the ventral margin. This curved portion is projected slightly beyond the umbones (anteriorly). Posterior to the beaks the area widens out into a conspicuous escutcheon. The posterior end curves regularly to the ventral margin, and the ventral margin curves slowly to the anterior end. On the side, where the rounded dorsal portion changes to a straight wedge-shaped ventral portion of each valve, a ridge extends diagonally from the umbo down to the ventral side of the posterior margin.

"This is a description of a Cardiomorpha, a shell not heretofore recognized in Maryland or West Virginia, but mentioned in Ohio as found in the Brush Creek, Cambridge (Pine Creek), and Ames. Apparently the shell is a variety of missouriensis, from which it differs in greater extension of rounded posterior end.

"**Leda meekana** Mark ? A fragment of a shell appears to correspond to Leda rather than to Yoldia. The species named is reported from the Brush Creek Shale of West Virginia and from the Portersville of Ohio.

"**Bellerophon crassus var. wewokanus** Girty. A single good specimen and another poor one seem referable to this species.

"**Ostracoda.** Two species of ostracods are noted, one of which is like a form found in the shale from Westernport.

"From this slight assemblage of fossils the shale may come anywhere in the Conemaugh; but with shale located somewhere near the Brush Creek the very fact that the shale is fossiliferous favors its relation to a part of the Brush Creek rather than to a neighboring shale, which is reported non-fossiliferous. In its iridescence it is unlike all other samples of shale received."

"A handful of black argillaceous shale was collected on the north side of Potomac River half a mile west of Westernport, Maryland, and a tenth of a mile northwest of the Roy Friday mine. It is not iridescent like the shale from southwest of Piedmont, but like that shale it does contain concretions that are flattish, not uniform in size or shape, and without the characteristics of fossils. In fossil

content the two are very different, but the material is not sufficient to furnish a fair comparison.

"**Lingula carbonaria** Shumard. The complete outline of a shell and a fragment of the shell itself are present, agreeing with Shumard's description.

"**Nucula parva** McChesney. The form found is about half a millimeter in length and the same in height; no concentric lines visible in the casts. None of the reports at hand quote McChesney's original description and none give figures; but Keyes gives a brief description that seems applicable.

"**Edmondia (?).** There are four minute shells, apparently of two individuals, each shell one and a half millimeters long, three-fourths of a millimeter high; concentric lines of growth evident. The shells correspond to young Edmondia except in that they have distinct beaks, and no depression posterior to beaks. There is no description of an ostracod that fits. If the shells are shells of Edmondia they are not of any species of which we have descriptions.

"**Plagiostoma acosta** Cox. Two shells are three millimeters long, one and a half millimeters high, and wide in proportion to height. The hinge line is straight, and at an angle of about fifty degrees with the oblique height of the shell. Apparently each shell is smooth.

"This description does not fit any of the pelecypods listed in the Conemaugh of the State, but the form named is reported from Kentucky and Illinois.

"**Igoceras (?).** This shell is conical, three millimeters in diameter and a millimeter and a half in height; beak rounded, not incurved, and without perforation. The base is a coarse sinuous line. This type of shell is not mentioned in the lists of Conemaugh fossils, and I fail to find one like it described in any literature at hand. It is higher than any brachiopod of either the Atremata or the Neotremata divisions; and no reference at hand recognizes the genus outside of the Mississippian; hence the question mark placed after the genus.

"**Gastropoda.** Portions of three minute shells seems referable to this group of shells. One has faint transverse lines that may actually be septa of a **Nautilus.** A second may possibly be a very regular and smooth **Serpula.**

"**Ostracoda.** There are four species of ostracoda present, one of which is **Leperditia.** One of the other genera present is also found in the shale from southwest of Piedmont.

"**Insecta.** A faint impression suggests part of an insect's wing.

"Range of Recognized Species, Brush Creek Shale.

Species.	Brush Creek	Pine Creek.	Ames.	Conemaugh in general.
Lingula carbonaria Shumard	*	*	*	.....
Cardiomorpha missouriensis Shumard ?	*	*	*	.....
Nucula parva McChesney	*	*	*	.....
Leda meekana Mark ?	*	?	?	.....
Plagiostoma acosta Cox	.....	.....	.....	*
Bellerophon crassus var. wewokanus Girty	*	*	*	.....

"It is hopeless to identify the horizon with so little material. The three species found may come from anywhere in the Conemaugh.

The presence of so many undescribed forms is against the supposition that the shale is Brush Creek Shale. On the other hand, if it is true that shale near the Brush Creek Shale is non-fossiliferous, and this shale was obtained from somewhere near the Brush Creek horizon the fact that fossils are found does to that extent favor considering the shale to be Brush Creek, but the fossils do not prove it."

"The third location is described as half a mile north of Hubbard, Maryland. The shale was judged to be Brush Creek Shale. It is bluish in color, argillaceous, containing a few casts and impressions too imperfect for identification. One fossil is of a low spired gastropod without special characteristics. Two others are somewhat Leda-like. There are two small impressions of minute pelecypods, and two small forms that suggest ostracods, completing the list. The original material is completely dissolved away, leaving only faint impressions of forms as above described."

VERTEBRATE FOSSILS, ALLEGHENY SERIES.

In the Allegheny Series, a General Section of which is published on pages 233-4, no marine invertebrate fossils were observed in either county, although the Vanport Limestone of the lower part contains them in regions farther west. The series has proved to be of much paleontologic interest, however, because of the presence of amphibian (reptilian) tracks on the top of the East Lynn Sandstone in Garrett County, Maryland, 0.4 mile south of Bloomington, Maryland and 0.4 mile northeast of Hampshire, Mineral County. As already mentioned, pages 237 and 724, these tracks were examined by Dr. R. S. Lull of Yale University, at the request of the West Virginia Survey. His paper describing them, together with additional remarks on a fossil bone previously found by Ray V. Hennen, in the Conemaugh Series (but not in place) in Braxton County, West Virginia, is as follows:

Probable Reptilian Footprints from the Maryland Carboniferous.

By

Richard Swann Lull,

Yale University.

A very interesting although baffling phenomenon has recently been brought to the writer's attention. It proves to be unquestionably of organic origin and may only be interpreted as representing the spoor of some ancient denizen of Carboniferous time.

Information concerning the locality came to Doctor I. C. White, director of the West Virginia Geological Survey, years ago through Mr. James Parsons, chief engineer of the West Virginia Central Railroad Company, who discovered it when engaged in the survey of the railway line up the North Potomac River more than thirty years since. Mr. David Reger, assistant geologist of the West Virginia Survey, has been carrying on investigations in the region of the Piedmont quadrangle, and last summer, at Doctor White's suggestion, sought for and rediscovered the footmarks in question. As the phenomena are actually on the Maryland bank of the river, they were brought to the attention of the Maryland Geological Survey, through Doctor E. B. Mathews, and the two state surveys, working conjointly, have referred the problem to the writer for report.

Locality.—The footprints are impressed upon a bed of massive sandstone which forms a ledge but little above the water level of the North Potomac River on the estate of Mr. William Brydon, near Bloomington, Maryland, and opposite Hampshire, West Virginia. The geological horizon is Pennsylvanian, near the middle of the Allegheny series, the bed of sandstone immediately overlying the lower Kittanning coal.

Description of footprints.—The first impression one gets of the phenomena is that they are not footprints at all, but rather that they must be the result of the weathering out of sandstone of some foreign bodies such as claystone concretions, the molds of which would thus remain behind. Some are indicative of nothing known to Ichnology, others are more suggestive of organic origin, especially when certain elements are considered, such as the curious deeply impressed tetrafoil always with the same orientation, the approximately equal size, and the extreme regularity or recurrence. There are many of the impressions, at least thirty in several series, and further exposure of the ledge, which is now partly covered by

a pumping engine and boilers, would doubtless expose many more (see Plate XXXVIII). Most of the impressions are complicated by being compounded of both fore and hind footprints; such for instance is Plate XLI, Figure 1, and this may be true of nearly all, for never does one find separate tracks of nanus and pes impressed individually but close together as in most of the quadrupedal trails known to science. Figure 2, of Plate XLI, however, seems to be an exception and to represent the impression of a single foot. The stride is long compared with the size of the foot, as the photographs (Plates XXXVIII and XXXIX) show, and the trackway is very wide.

The footprints show at least four, probably five, digits, but in two instances, one of which is here shown (Figure 1 of Plate XLI), there are marks of three digital terminals some distance in advance of the remainder of the impression. Pads are very distinctly indicated, but are somewhat difficult to homologize accurately in successive tracks. A deeply imprinted sole pad is always present, usually with four divisions, although the first impression one gets of it is that of a trefoil not unlike the sole pad of a modern dog, but unlike the latter with a single division directed toward the rear. The sole pad may be 25 to 28 mm. below the general surface of the rock, the remainder of the footprint being much less deeply impressed. The creature was at least semi-plantigrade in its sprawling gait.

The size of the animal, together with its distribution in time and place, indicates the maker as amphibian, probably one of the temnospondylous Stegocephalia, like **Eryops**, the bones of which, while mainly Permian, have also been found in the Coal Measures of Pennsylvania[1]. There is also a degree of probability that the impressions may have been made by a true reptile of the order Cotylosauria, which embraces the transitional forms next above the Stegocephalians in evolutionary sequence, and like them heavily armored, but differing, aside from certain anatomical details, in the abandonment of gill-breathing during the adolescent stage. The footprints, even were their morphology more readily interpretable, would probably not show the distinction, but a further study of local environmental conditions as indicated by the character of the sandstone upon which the footprints are impressed would give a clue, as the reptile could exist under conditions of prolonged aridity which would be a deterrent to the amphibian.

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[1] W. D. Matthew, American Journal of Science (4), Volume 11, 1911, page 199.

Photo by E. E. HARRIS.

PLATE XXXVII.—Fossil footprints of **Dyscritishnus piedmontensis,** on surface of East Lynn Sandstone at Bloomington, Maryland.

Dyscritichnus[2] piedmontensis, n. gen., n. sp.

Manus.—Four- or five-toed, heel narrow, digits rounded, without claws, impression of toes in contact, tetrafoil pad deeply impressed.

Pes.—Larger, number of digits (at least three) generally obscured by manus, apparently less deeply impressed than the manus except for the sole pad. Track about equals **Thenaropus heterodactylus** King from Westmoreland County, Pennsylvania, in size, otherwise the resemblance is not close, nor is it distinctly comparable with any other known footprint.

Measurements are as follows:

	mm.
Manus:	
Length	104
Distance between lateral toes	85
Compound Impression:	
Length	166
Distance between lateral toes	90
Length of stride	360-560
Width of trackway, about	300

The limb bone cast described by Case[3] and called by Doctor White **Pareiasaurus? henneni,** while it comes from a somewhat higher horizon (Conemaugh) than the footprints under consideration, has been interpreted as the radius of a Parieasaur-like cotylosaurian on anatomical grounds. It indicates a larger animal than our footprint maker, but the combined evidence of the two phenomena, which are corroborative rather than antagonistic, points to the presence in the Pennsylvanian of primitive land vertebrates of large size.

Concerning the Braxton "bone," which has given rise to some discussion as to its actually being an organic relic, it is the general feeling of the paleontologic staff at Yale, to whom, through the courtesy of Doctor White, the specimen has been referred, that it is a cast in very fine sandstone of the cavity left by the solution of a bone, and hence a micro-section shows no osseous structure nor does it indicate that the mold was filled by a mineral in solution. To meet the very natural objection that such sandstone casts are generally imperfect on one side, Doctor Wieland suggests that perhaps the animal was mired with the distal segments of its limbs in the vertical position, in which event not one side but the proximal end would be imperfect, an interpretation which is in accordance with Case's description of the morphology of the bone itself.

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[2] ΔΥΣΚΡΙΤΟΣ = difficult to understand.

[3] E. C. Case, West Virginia Geological Survey, Report Braxton and Clay Counties, 1917, pages 817-822.

The use of the generic name **Pareiasaurus**, even with the query, has been rightly objected to on faunal grounds. Case only speaks of the animal as pareiasaur-like. I venture to suggest, therefore, that the name **Pareiasauroides** be substituted, and that the creature whose existence is thus recorded be called **Pareiasauroides henneni** (White).

(Note by I. C. White.)

This suggestion of Doctor Lull is a good one; viz, to change the generic name of the fossil bone doubtfully given as **Pareiasaurus** to **Pareiasauroides** and this substitution is hereby accepted by the writer, and the two plates illustrating the character of Pareiasauroides henneni (White) are herewith reproduced, as Plates XLII and XLIII together with their accompanying explanatory notes, as heretofore published in the volume on Braxton and Clay Counties, pages 820 to 821, 1917. (I. C. W.).

ILLUSTRATIONS.

Plate XXXVIII.—Ledge bearing several trails of **Dyscritichnus piedmontensis**, n. gen., n. sp. The North Potomac may be seen, with West Virginia beyond.

Plate XXXIX.—Three successive double impressions of one animal, two rights and one left. The same impressions may be seen crossing the middle of the ledge from left to right in Plate XXXVIII. See also Plate XLI, Figures 2 and 3.

Plate XL.—Enlarged view of right forward impression seen on Plate XXXIX. See also Plate XLI, Figure 3. Somewhat less than natural size.

Plate XLI: Figure 1.—Compound impression of manus and pes, left side. The deep sole pad of each is present, together with the three "claw" marks apparently of the pes. A crack runs through the footprint.

Figure 2.—Imprints of left manus, in foreground of Plate XXXVIII, showing digits.

Figure 3.—Right imprints of manus and pes showing digits of manus and deep sole pad.

All x $\frac{1}{2}$.

Plate XLII: Figure 1.—Lateral view of the West Virginia specimen, **Pareiasauroides henneni** White. See Braxton and Clay Report of West Virginia Geological Survey, pages 817-822, 1917, for original discussion.

Figure 2.—View of the opposite side of the West Virginia specimen.

Figure 3.—View showing the sharp ridge on the West Virginia specimen.

Figure 4.—Outline of the cross-section of the West Virginia specimen at the cut.

Figure 5.—Radius of **Propappus rogersi.** After Broom.

Figure 6.—Radius of **Pareiasaurus serridens.** After Broom.

Figure 7.—Radius of **Pareiasaurus baini.** After Beeley.

All figures x $\frac{1}{4}$.

Plate XLIII.—Photographs of the West Virginia specimen, **Pareiasauroides henneni** White, as originally discussed in the Braxton and Clay Report of West Virginia Geological Survey, pages 817-822; 1917.

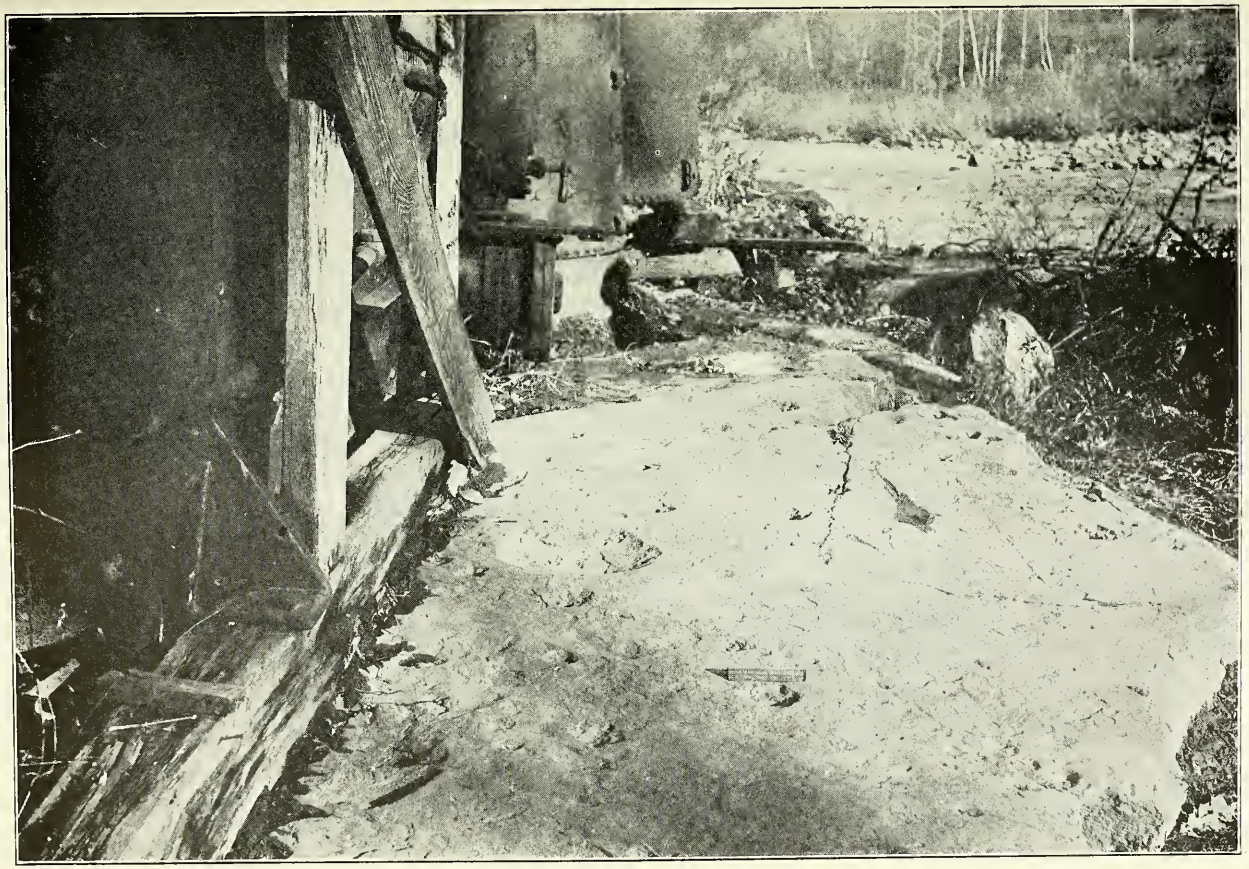


Photo by C. W. RICHARDSON.

PLATE XXXVIII.—Ledge bearing several trails of **Dyscritichnus piedmontensis**, n. gen. n. sp. The North Potomac may be seen, with West Virginia beyond.

Photo by C. W. RICHARDSON.

PLATE XXXIX.—Three successive double impressions of one animal, two rights and one left. The same impressions may be seen crossing the middle of the ledge from left to right in Plate XXXVIII. See also Plate XLI, Figures 2 and 3.

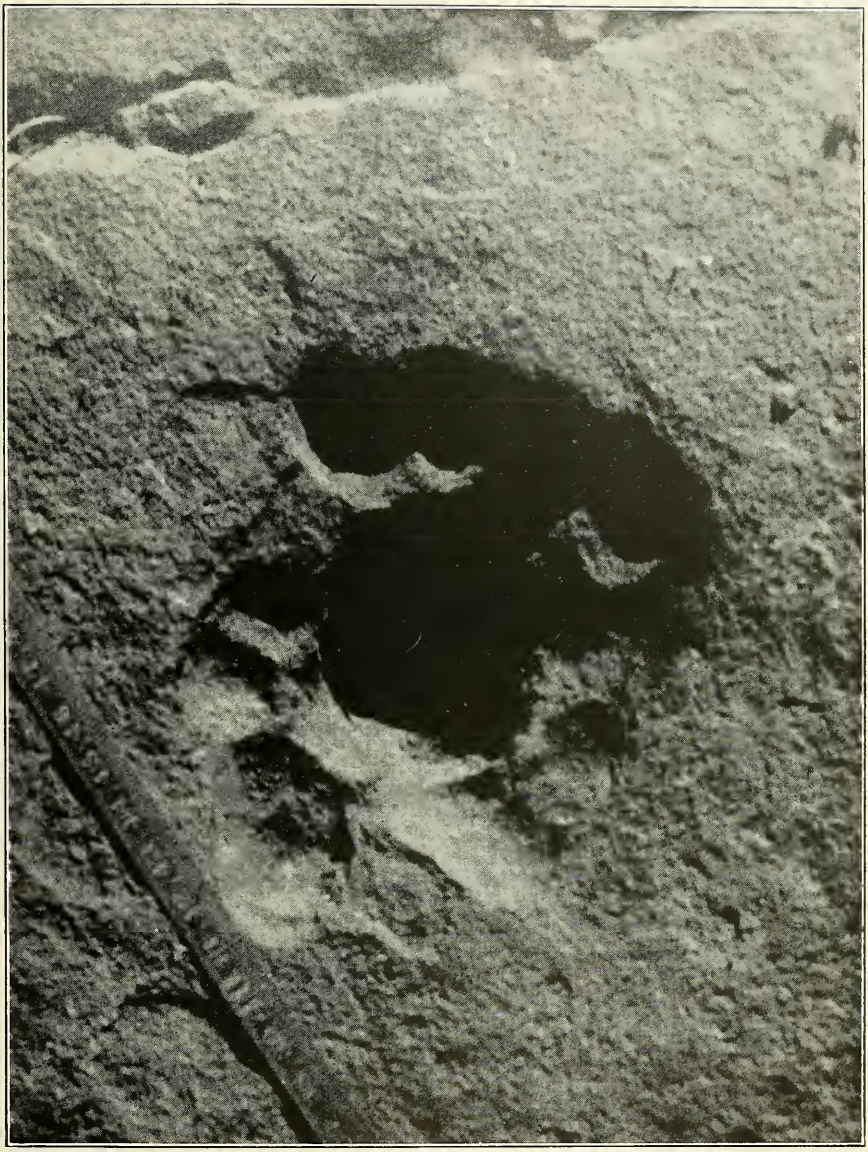


Photo by C. W. RICHARDSON.

PLATE XL.—Enlarged view of right forward impression seen on Plate XXXIX. See also Plate XLI, Figure 3. Somewhat less than natural size.

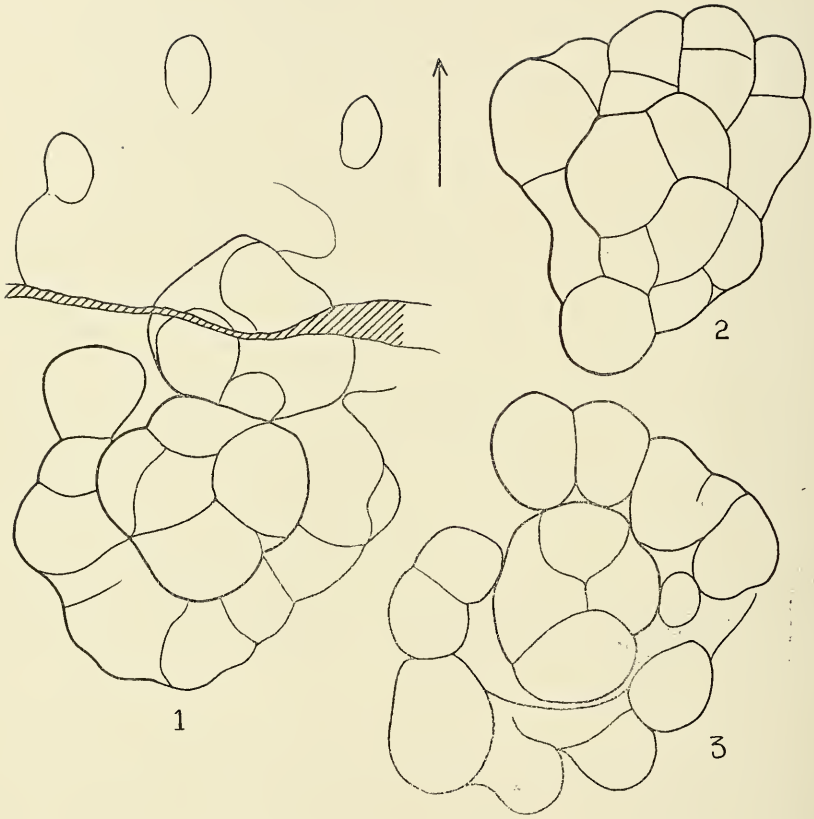
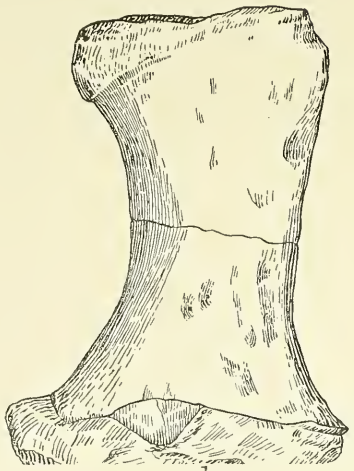


PLATE XLI.—Figure 1.—Compound impression of manus and pes, left side. The deep sole pad of each is present, together with three "claw" marks, apparently of the pes. A crack runs through the footprint. Figure 2.—Imprints of left manus in foreground of Plate XXXVIII, showing digits. Figure 3.—Right imprint of manus and pes showing digits of manus. All x ½.



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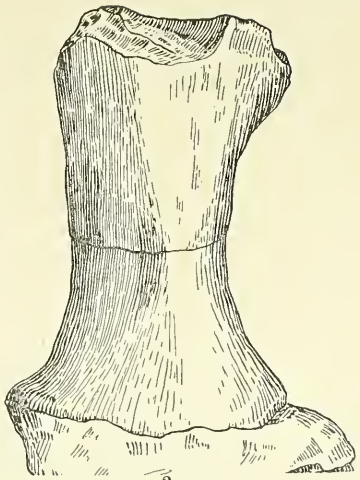

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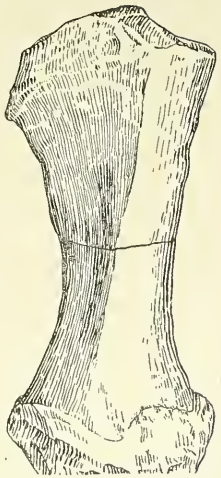

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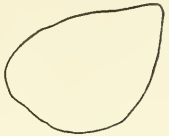

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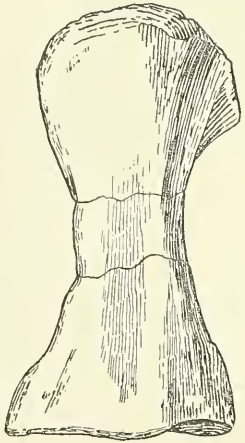

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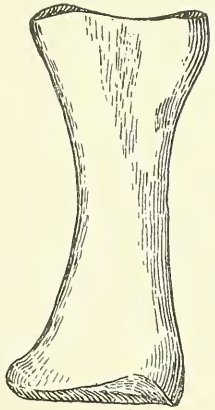

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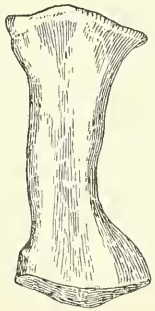

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PLATE XLII.—See List of Illustrations in Introductory Matter. —Figs. 1-4 are West Virginia specimen **Pareiasauroides henneni** White. See Braxton and Clay Report of W. V. G. S. pp. 817-822, 1917, for original discussion.

PLATE XLIII.—Photographs of the West Virginia specimen, **Pareiasauroides henneni** White, as originally discussed in the Braxton and Clay Report of W. V. G. S., pp. 817-822, 1917.

MARINE INVERTEBRATE FOSSILS, POTTSVILLE SERIES.

In the Pottsville Series, a General Section of which is published on page 250, marine invertebrate fossils were not found in either county, but in Allegany County, Maryland, a small collection was made by the writer in the public road north of North Branch of Potomac River 0.8 mile southeast of Westernport, Maryland, and the same distance southeast of Piedmont, West Virginia. Dr. Tilton's discussion of this collection is as follows:

"The two specimens were obtained along the public road north of Potomac River about a mile below Westernport, Maryland. They are of dark shale, somewhat slaty, containing numerous glistening surfaces of a dark mineral; and the rock as a whole has a very dark brownish cast as if hematite were present in the clay.

"There are two distinct branches of plants present. The only fossil of animal origin that is present is **Naiadites elongata** Dawson. As this species is reported from the Kanawha Black Flint, Quakertown Shale, and Newlon Shale of the Kanawha Group, and from Hartridge Shale, of the New River Group, the fossil does not identify the shale closer than the Pottsville Series. This is the only fossil mentioned in four other locations of the Quakertown Shale. It seems, therefore, that the presence of **Lingula kanawhensis** Price can not be relied upon for the identification of the Quakertown Shale, and its absence in the present instance is without significance."

MISSISSIPPIAN FOSSILS.

As previously mentioned, pages 274-5, marine invertebrate fossils were found in one member of the Mauch Chunk Series of the Mississippian in Garrett County, Maryland, near the Mineral County Line, but they were not observed in the area under study. No collection was made at the Garrett County exposure, although a list from this far northern locality would be of much interest in connection with the ultimate correlation of the Mauch Chunk measures across the State of West Virginia.

In the Greenbrier Limestone, described on pages 277-9, there is an abundance of marine invertebrate fossils, but no collections were made in either county by the writer. In the North Potomac Section of Dr. White, page 145, a few identifications are made. It has already been noted (page 272) that a large collection made from the Greenbrier by the writer in southern West Virginia where the group reaches almost, if not quite, its maximum development, will soon be made available to patrons of this Survey through the identifications of Dr. George H. Girty, of the United States Geological Survey, who also spent a few days in the field.

In the Pocono Series of the two counties no faunal remains were observed in either county. This group is usually barren, although a few marine invertebrate fossils have been

found in it at isolated localities in West Virginia, Pennsylvania, and perhaps elsewhere.

UPPER DEVONIAN FOSSILS.

In the Upper Devonian, the stratigraphy of which has been described in Chapter XI, pages 284-307, inclusive, marine invertebrate fossils are generally found in several, if not all, of the major subdivisions. In Mineral and Grant Counties, however, the faunal life of the Upper Devonian does not appear to have been as well developed as in some other regions.

In the Catskill Series, the stratigraphy of which has been described on pages 287-291, inclusive, marine fossils were not observed. In certain other counties a limited fauna with Chemung affinities appears to recur in the lower portion of the Catskill, probably due to the segregation of salty pools where conditions still remained favorable to marine life while at the same time it could not exist in the surrounding regions.

In the Chemung Series there was marine life in Mineral and Grant Counties but it lacked the abundance that may be noted in some other regions. In the Portage no fossils were observed, although there is a fairly numerous fauna reported in Maryland, farther eastward, and it may be that a more extended search might reveal recurrences in Mineral and Grant Counties. The tendency of this group to lose its fauna in passing westward toward the Appalachian Basin is well known.

In the Genesee Series there is a sufficient marine fauna in Mineral and Grant Counties to warrant its identification with the type locality in New York State and to justify its description as a separate subdivision.

MARINE INVERTEBRATE FOSSILS, CHEMUNG SERIES.

In the Chemung Series, the detailed description of which is published on pages 291-301, inclusive, three collections were made by the writer, all in Mineral County. One of these came from a prolific sandstone horizon at the very top of the series which was taken to be probably much the same as the Hendricks Sandstone of Tucker County which belongs in the Catskill-Chemung contact zone, as has been previously discussed, pages 289-291. When this collection was made no detailed list of the fossils from the type locality of the Hendricks was available for the use of Dr. Tilton who examined the three collections and who reported the supposed Hendricks in accordance with the field identification of the writer, without special comment as to its age. At a later date additional collections were made by Prof. Scheffel and Paul H.

Price from this and other localities in the supposed Hendricks, and at the same time the original collections made from two localities of the Hendricks in Tucker County were shipped to Dr. Prouty for comparison along with the Mineral County collections of Prof. Scheffel and Paul H. Price. His verdict, as will later appear, is that the supposed Hendricks of Mineral County appears to be slightly older than the typical Hendricks although evidence is not conclusive.

Dr. Tilton's report on the three collections of the writer, changed by the proper injection of a question mark after the name "Hendricks," is as follows:

"The Chemung fossils are from three localities, all in Mineral County, West Virginia. One is Broad Hollow of Dan Run of the North Branch of Potomac River, 5 miles southwest of Green Spring, where the specimens were obtained from the base of the Chemung. A second is at Markwood on Mill Creek of Patterson Creek, where the specimens were obtained from somewhere in the midst of the Chemung. A third is from the Hendricks (?) Sandstone, 1.6 miles northwest of Keyser, from the highway cut two hundred and forty feet west of Z Tower of the Baltimore and Ohio Railroad.

The specimens from Broad Hollow are in dense brownish sandstone cemented by hematite, and though fossils are very numerous in a portion of the stone the results of solution have left no trace of lime, the fossils being preserved in casts and moulds. Here are found **Atrypa reticularis** (Linn.), **Spirifer disjunctus** Sowerby, **Tropidoleptus carinatus** Conrad, **Camarotoechia eximia** Hall, **Leptodesma medon** Hall, and **crinoid stems.** Atrypa reticularis Linn., represented by one imperfect specimen, may be found throughout the Devonian. Camarotoechia eximia Hall is reported from both Hamilton and Portage, but it is most abundant in the upper Chemung. Spirifer disjunctus Sowerby is recognized as a marker of the Chemung. It is more abundant in the upper part of the Chemung than in the lower part of it.

"At the second locality, Markwood, the specimens are in a dark-gray siliceous limestone coated with oxide of iron. The following fossils are identified:

Ambocoelia umbonata Conrad
Camarotoechia eximia Hall
Dalmanella tioga Hall
Spirifer disjunctus Sowerby
Leptodesma medon Hall
Cyclonema multistriata Prosser and Kindle
Loxonema (moulds and casts)
Crinoid stems.

"Here Spirifer disjunctus Sowerby distinguishes the beds as Chemung in age, a conclusion emphasized by the presence of Dalmanella tioga Hall, and the abundance of pelecypod and gastropod remains. The moulds and casts of Cyclonema multistriata Prosser and Kindle and of a form thought to be Loxonema are abundant.

"At the third locality, 1.6 miles northwest of Keyser, the fossils

are in a gray sandstone cemented with iron that weathers to a yellowish brown. Here **Camarotoechia eximia** Hall is particularly abundant, along with **Spirifer disjunctus** Sowerby and with **Atrypa reticularis** Linn. There are also present fragments of leaves, apparently of **Cycadofilices.**

"Range of Recognized Species, Chemung Series.

Species.	Helderberg.	Oriskany.	Marcellus.	Hamilton.	Genesee.	Tully.	Portage.	Chemung.	Catskill.
Ambocoelia umbonata Conrad	*	..	*	*	..	*	*	*	..
Atrypa reticularis Linn. ?	*	*	..	*	..	..	*	*	..
Camarotoechia eximia Hall	..	..	..	*	..	..	*	*	..
Dalmanella tioga Hall	..	..	..	..	..	..	..	*	..
Spirifer disjunctus Sowerby	..	..	..	..	..	..	..	*	..
Tropidoleptus carinatus Conrad	..	..	*	*	..	..	*	*	..
Leptodesma medon Hall	..	..	..	..	..	..	..	*	..
Cyclonema multistriata Prosser and Kindle	..	..	..	..	..	..	*	*	..

"Atrypa reticularis Linn. is found throughout the Devonian, especially the Helderberg. Tropidoleptus carinatus Conrad is also found throughout the Devonian, particularly in the Middle portion. Ambocoelia umbonata Conrad, while found throughout the Devonian, is said to be numerous in beds just below the Spirifer disjunctus Sowerby horizons and to be common through the Chemung. There was but one specimen among those examined. Camarotoechia eximia Hall, while found to some extent in the Hamilton, is especially abundant in the upper part of the Chemung. It is closely related (through C. contracta Hall) to forms that existed both at the same time and later (in the Mississippian). Cyclonema multistriata Prosser and Kindle is reported from the Portage (Parkhead) of Maryland, but is otherwise confined to the Chemung. Spirifer disjunctus Sowerby, Dalmanella tioga Hall, and Leptodesma medon Hall are forms that are restricted to the Chemung."

In Tucker County a collection from the Hendricks Sandstone was made by Dr. W. Armstrong Price, former Paleontologist of the Survey, at its type locality (No. 223) along a hill road just east of Falls Run of Dry Fork of Cheat River immediately north of the town of Hambleton and 1 mile northwest of Hendricks, at elevation 1815′ B. The idntification of these fossils was never completed by Dr. Price during his connection with the Survey, there being a partial list on page 246 of the Tucker County Report. A large part of the original collection was then sent to Dr. Prouty, as previously noted, his list of the fossils being as follows:

Lingula cf. oherni Hall and Clarke c.
Camarotoechia contracta Hall aa.
Leptodesma medon Hall aa.
Sphenotus cf. contractus Hall r.
Palaeantina sp.
Leptodesma ?

Bryozoa sp.
Ostracod sp. smooth
Crinoid stem.

Another collection was made in Tucker County at Locality 212 on Close Mountain 0.1 mile east of Close Mountain School and 1.2 miles southeast of Leadmine village and 7 miles northward from Hendricks and on the same (western) side of Backbone Mountain by Dr. W. Armstrong Price and the writer, this being the original point of discovery of the zone by the latter, the name of Hendricks being later applied because of its more easy access. Dr. Prouty reports as follows on a shipment of fossils from Locality 212:

Camarotoechia contracta Hall aa.
Sphenotus contractus Hall a.
Bryozoa sp.

Returning now to Mineral County, the four following collections were made in the Chemung by Prof. Scheffel and Paul H. Price, with identifications and comment by Dr. Prouty. The writer has inserted a question mark after the Hendricks Sandstone to indicate its supposed uncertainty:

Mineral County; in highway cut along Keyser-Piedmont road, 1.6 miles northwest of Keyser Station at second telephone-pole west of "Z" Tower of Baltimore and Ohio Railroad. Extreme top of Chemung. See No. 14 of Keyser Section, page 140. (Labeled 900-K-1-31, D. B. R., p. 201, etc.; E. R. S., p. 560):

Spirifer disjunctus Sowerby aa.
Camarotoechia congregata var. parkheadensis Clarke & Swartz aa.
Camarotoechia contracta ? a.
Leptodesma sp.

"Chemung in age. Hendricks (?) Sandstone."

Mineral County; in highway cut along Keyser-Piedmont road, 1.5 miles northwest of Keyser and 200′ east of "Z" Tower of Baltimore and Ohio Railroad. Probably about 200′ to 300′ below top of Chemung. See No. 17 of Keyser Section, page 140. (Labeled 910S, K-1-31, E. R. S., p. 561):

Leptodesm a sp.
Cypricardella sp. a.
Spirifer disjunctus Sowerby a.
Schuchertella cf. chemungensis Conrad
Crinoid stems.

"Chemung in age."

Mineral County; on Northwestern Pike 2.7 miles southwest of Claysville. Fossils in 10′ of brown, flaggy sandstone; reds above and green below. Elevation, 1850′ B. Extreme top of Chemung. See No. 10 of Claysville Section, page 153 (2 collections labeled 1850′ B., Eg. 8-5, D. B. R., p. 224; P. H. P., p. 200; E. R. S., p. 510c):

Spirifer disjunctus Sowerby aa.
Camarotoechia congregata var. parkheadensis Clarke & Swartz a.
Camarotoechia contracta Hall
Ambocoelia umbonata ? Conrad
Gomphoceras ?
Leptodesma cf. lichas Hall
Orthoceras sp.
Camarotoechia cf. contracta
Pelecypod fragments.
"Chemung in age. Hendricks (?) Sandstone."

Mineral County; along cut of abandoned narrow-gauge railroad just northwest of Markwood, on east side of short branch of Mill Creek of Patterson Creek, just north of Northwestern Pike. Fossils in ferruginous bands of sandstone probably near middle of Chemung. No section measured. (Labeled Dck. K-4-52-900 ? E. R. S., pp. 575-576):

Cyclonemina multistriata Prosser & Kindle aa.
Productella lachrymosa Conrad
Cf. Loxonema glabium Prosser & Kindle
Tropidoleptus carinatus (small like those in Parkhead member).
Tentaculites sp.
Spirifer mucronatus var. cf. posterus Hall & Clarke r.
Camarotoechia congregata var. parkheadensis Clarke & Swartz
Crinoid stem
Coleolus cf. tenuicinctus Hall
Orthoceras sp.
"Chemung in age."

MARINE INVERTEBRATE FOSSILS, GENESEE SERIES.

In the Genesee Series, the detailed description of which is published on pages 305-7, inclusive, the writer made one collection in Mineral County, described as follows by Dr. Tilton, together with his remarks concerning the Tully Limestone:

"**Tully** ?—The collection contains no specimens from the Tully Limestone. Inasmuch as the formation in Pennsylvania thins down from fifty feet in Columbia and Montour Counties to five feet in Huntingdon County it is possible that it is absent in West Virginia, but some evidence of its former presence, or an unconformity, should be carefully sought at the top of the Hamilton Shale and beneath the Genesee Shale.

"**Genesee.**—The Genesee Shale is hard and very dark gray. It has been collected from but one locality: Staggs Run of Patterson Creek, 1.4 miles west of Headsville, Mineral County, West Virginia.

"The shale contains numerous **Styliola fissurella** Hall, so many that it may be called a Styliola shale. Along with these are other forms, some of which are large enough to present differences on which they are judged to be **Bactrites aciculatus** Hall, a cephalopod. Along with these are other forms, given in the following table, together with the range of species as given in the New York, Pennsylvania, and Maryland reports:

Range of Recognized Species, Genesee Series.

Species.	Helderberg.	Oriskany.	Marcellus.	Hamilton.	Genesee.	Tully.	Portage.	Chemung.	Catskill.
Lingula spatulata Vanuxem	..	..	..	*	*	..	*	..	..
Grammysia subarcuata Hall	..	..	..	..	*	..	..	..	..
Paracardium doris Hall (a)	..	..	..	..	*	..	*	..	..
Pterochaenia (Lunulicardium) fragile Hall (a)	..	..	..	..	*	..	*	..	..
Styliola fissurella Hall	*	..	*	*	*	..	..	..	..
Bactrites aciculus Hall	*	..	..	..	*	..	..	*	..
Tornoceras uniangulare Conrad	..	..	..	..	*	..	..	..	..

(a) Especially common, guide.

"While Lingula has a great range L. spatulata Vanuxem is not reported from the Devonian below the Hamilton. Styliola fissurella Hall and Bactrites aciculus Hall are reported from the Helderberg of Maryland, and Styliola fissurella is also reported from the Marcellus and Hamilton of all three States: New York, Pennsylvania, and Maryland. Grammysia subarcuata Hall, and Tornoceras uniangulare Conrad are reported from the Genesee only. Lingula spatulata Vanuxem, Pterochaenia fragile Hall and Paracardium doris Hall are also reported from the Portage. Bactrites aciculus Hall is the only species that survives through the Chemung. Such a record presents absolute proof that the shales from which the species came are Genesee shales."

Three collections from the Genesee were also made by Prof. Scheffel and Paul H. Price, two of them being in Mineral County and the third in Grant. The description of these localities, together with identifications and comment by Dr. Prouty, is as follows:

Mineral County; in cut along Northwestern Pike on branch of Mill Creek of Patterson Creek 0.3 mile southeast of Ridgeville. **Collection A** from upper portion. **Collection B** from lower portion. (Labeled 1020S, K-4-41; should be K-4-51):

Collection A:

Pterochaenia fragilis Hall
Pterochaenia fragilis var. orbicularis Clarke
Buchiola retrostriata Von Buch a.
Bactrites aciculus Hall
"Genesee in age. Slightly sandy, carboniferous and micaceous shale with some gypsum."

Collection B:

Pterochaenia fragilis Hall c.
Pterochaenia fragilis var. orbicularis Clarke c.
Buchiola retrostriata Von Buch c.
"Genesee in age."

Mineral County; on north side of Staggs Run of Patterson Creek, 1.3 miles west of Headsville. Collection from about 150′ of black fissile shale representing most of Genesee. No section measured. (Labeled 757 K-5-22 & 23, D. B. R., p. 354; E. R. S., p. 582):

Bactrites aciculus Hall c.
Probeloceras lutheri Clarke c.
Styliolina fissurella Hall a.
Buchiola cf. liviniae Clarke
Paracardium cf. doris Hall
Pterochaenia fragilis Hall a.
Pterochaenia fragilis var. orbicularis Clarke a.
"Genesee in age."

Grant County; on north side of Lunice Creek, 0.3 mile east of Maysville. Elevation, 1265′ B. Collection from 36′ of brown shale with shaly, fossiliferous limestone at top of Hamilton. See No. 2 of Maysville Section, page 176. (Labeled 1265B, Gg. 5-31 and 41, D. B. R., p. 384c; E. R. S., pp. 516-518):

Pterochaenia fragilis Hall a.
Pterochaenia fragilis var. orbicularis Hall
Nucula sp. near N. corbuliformis Hall
Diaphorostoma sp.
cf. Bactrites aciculum Hall
Liorhynchus sp.
Buchiola sp. aa.
Straparollus sp.
"Dark-colored shale with small fossils. Genesee in age."

MIDDLE DEVONIAN FOSSILS.

In the Middle Devonian, fossils are abundant in both the Hamilton and Marcellus Series, which are the two subdivisions recognized in Mineral and Grant Counties.

MARINE INVERTEBRATE FOSSILS, HAMILTON SERIES.

In the Hamilton Series, a description of which is published on pages 308-314, inclusive, five collections were made by the writer, the report on which by Dr. Tilton is as follows:

"There are collections from five different localities in the Hamilton Shale. In general the material is weathered, but in one place, in a Baltimore & Ohio Railroad cut 0.2 mile north of Twenty-first Bridge, Allegany County, Maryland, the collection is from the dark-gray, nodular concretions described as at six hundred to seven hundred feet above the Oriskany Sandstone (see No. 2 of Twenty-first Bridge Section, page 321). Here **Chonetes marylandica, Nuculites triquiter** Conrad, and **Palaeoneilo tenuistriata** Hall ? are common. Other forms found are **Tropidoleptus carinatus** Conrad and **Modiomorpha (?).**

"At the extreme head of South Mill Creek in the public road two and a half miles northeast of Kline and one mile northeast of Lough School, Pendleton County, West Virginia, the greenish and brownish shale contains numerous **Stereolasma rectum** Hall and **Phacops rana** Green. The collection also includes the cast of a gastropod that is judged to be **Macrochilus hamiltoniae** Hall.

"On the east side of Knobly Mountain, in the public road 0.8 mile southwest of Antioch, Mineral County, West Virginia, the brownish and greenish shale is very fossiliferous. **Monticulipora (?) marylandensis** Prosser and **Spirifer mucronatus** are especially common. Here are also found **Chonetes marylandicus** Prosser and Kindle, **Nuculites triquiter, Spirifer sculptilis, Rhipidomella (sp. ?), Aviculopecten princeps** Conrad. The calcareous material has been completely leached out. Through the iron-stained shale that is left run numerous stems and fronds of **Bryozoa. Fenestella, Taeniopora,** and **Monticulipora (?) marylandensis** Prosser are distinctly represented, but all possibility of study of cross-sections has been destroyed by solution. A minute coral approaching **Streptelasma** in type is present but without characteristics that lead to its identification. There is also a grouping of forked plates of a **Blastid.**

"A fourth locality is in the public road on Painter Run of Patterson Creek, 0.6 mile southeast of Frankfort (Alaska P. O.), Mineral County, West Virginia. Here in the greenish and brownish shale are found what seem to be plant stems or roots. **Fenestella (sp. ?)** is present, along with **Chonetes marylandicus** Prosser and Kindle, **Nucula bellistriata** Conrad, fragments of **Spirifer, Grammysia (sp. ?)** and **Palaeoneilo (sp. ?).** There is one specimen that is a portion of **Orthoceras (sp. ?).** A very conspicuous form is that of a long slender cylinder with numerous cross-sections of tabular-like partitions with slender central rods extending from one tabulum to the next. The original calcareous material is completely removed, leaving only the mould as a whole and these casts in the interior in the fine iron-stained shale. Possibly these are cirri of **Blastids,** a form that has been noted in another place. Larger impressions of crinoid stems are found here as well as elsewhere. If these forms were of Bryozoans it is noted that the places for the individuals (zoecia) are without apertures, which would seem necessary for the existence of numerous individuals at the same time. The forms are not dendroid.

"The fifth locality is in the public road on Mill Creek of Patterson Creek, a fourth of a mile west of Burlington, Mineral County, West Virginia. At this point also **Fenestella, Taeniopora,** and **Hernodia humifusa** Hall are found in abundance. Here also are found **Cystiphyllum americanum** Milne-Edwards and Haime, **Heliophyllum (?)** and another coral without distinctive features for identification, crinoid stems, **Athyris spiriferoides** Eaton, **Rhipidomella** (sp. ?). **Spirifer mucronatus** Conrad, **S. granulosus** Conrad, **Tropidoleptus (?),** and a portion of a **Pelecypod.** The material is especially rich in fossils of all the kinds named."

The above locality is near the top of the Hamilton, since the Genesee soon outcrops on the westward dip.

In the Hamilton Series, also, six collections, partly in Mineral County and partly in Grant, were made by Prof. Scheffel and Paul H. Price, the descriptions of which, together with identifications and comment by Dr. Prouty, are as follows:

Mineral County; in highway cut just north of Mill Creek of Patterson Creek at west edge of Burlington. Elevation, 760′ B. Collection from 15′ of limy shale in upper portion of Hamilton. No section measured (Labeled 760B, K-4-55, D. B. R., p. 306; E. R. S., p. 580):

Heliophyllum halli E. & H. a.
Heliophyllum confluens Hall c.
Phacops rana Green
Atrypa reticularis Linnaeus r.
Spirifer cf. mucronatus Conrad c.
Spirifer fimbriatus Hall c.
Favosites cf. gothlandicus Goldfuss
Favosites sp. small tubes
Synoptophyllum sp.
Eridophyllum sp.
"Hamilton in age."

Mineral County; on branch of Liller Run of Mill Creek of Patterson Creek along Northwestern Pike just east of Ridgeville. Elevation, 1030′ to 1050′ B. **Collection No. 1** from higher portion, and **collection No. 2** from lower portion. See Ridgeville Section, page 138. (Labeled 1030-1050B, K-4-52, D. B. R., p. 382; E. R. S., p. 574):

Collection No. 1:

Camarotoechia cf. prolifica Hall r.
Ambocoelia umbonata Conrad r.
Chonetes cf. vicinus Castelnau
Chonetes cf. lepidus Hall
Crinoid stem.

"Hamilton in age."

Collection No. 2:

Ambocoelia umbonata Conrad aa.
Chonetes lepidus Hall a.
Chonetes cf. vicinus Castelnau
Actinopteria desussata Hall c.
Pleurotomaria (Gyroma) cf. capillaria Conrad
Nucula sp.
Crinoid stem.

"Hamilton in age."

Mineral County; on branch of Hilkey Run of Mikes Run of Patterson Creek, in road along eastern base of Knobly Mountain, 0.8 mile southwest of Antioch. Elevation, 1160′ B. Collection near base of Hamilton. No section measured. (Labeled 1160B, Eg. 9-24. D. B. R., p. 327c; E. R. S., p. 557):

Tropidoleptus carinatus Conrad c.
Spirifer mucronatus Conrad a.
Favosites sp.
Palaeoneilo emarginata Conrad c.
Ambocoelia umbonata Conrad r.
Chonetes mucronatus Hall c.
Taeniopora sp.
Fenestella sp.
Crinoid stem.
"Hamilton in age."

Grant County; in road just northeast of Oak Hill School, 1.8 miles northeast of Maysville. Collection in limy shales, lower portion of Hamilton. No section measured. (Labeled 1490S, Gg. 5-21, E. R. S., pp. 535-536):

Spirifer mucronatus Conrad aa.
Atrypa reticularis Linnaeus c.
Ambocoelia umbonata Conrad c.
Tropidoleptus carinatus Conrad c.
Productella cf. spinulicosta Hall r.
Athyris spiriferoides Eaton
Stropheodonta cf. perplana Conrad
Rhipidomella leucosia Hall
Spirifer sp.
Chonetes sp.
Crinoid sp.

"Hamilton in age."

Grant County; in road along North Mill Creek, 0.2 mile north of Landes. Elevation, 1115′ B. Two collections in brown shales with limestone coming near top of Hamilton. No section measured. (Labeled 1115B, P. 4-24, D. B. R., p. 419; E. R. S., pp. 512-513; Upper collection is marked Tully Limestone-Hamilton ?; lower is marked Hamilton Shales-Tully Limestone ?):

Both Collections:

Athyris spiriferoides Eaton a.
Atrypa spinosa Hall a.
Ambocoelia umbonata Conrad c.
Spirifer medialis Hall c.
Spirifer mucronatus Conrad c.
Loxonema hamiltoniae Hall r.
Leptaena rhomboidalis Wilckens r.
Orthoceras cf. subulatum Hall r.
Cf. Chonetes vicinus Castelnau r.
Palaeoneilo close to marylandica Prosser r.
Spirifer cf. consobrinus d'Orbigny r.
Fenestella sp.
Parazyga sp.
Meristella sp.
Favosites sp.
Chonetes sp.
Crinoid stems sp.

"Does not contain typical Tully fossils; seems to be Hamilton."

The above horizon was considered in the field as a possible representative of the Tully Limestone of New York State, since it has almost the same stratigraphic association. According to Dr. Prouty, however, it contains no Tully fossils. It was therefore given the name of Landes Limestone by the writer, as previously discussed, page 313.

Grant County; in road on North Mill Creek at Landes. Collection near top of Hamilton in 20′ to 25′ cliff of limy shale with no distinct limestones. No section measured (Labeled 1110S, P. 4-24, E. R. S., pp. 514-515):

Tropidoleptus carinatus Conrad a.
Stropheodonta perplana Conrad aa.
Orthis penelope Hall c.
Stropheodonta inaequistriata Conrad

Athyris spiriferoides Eaton
Spirifer mucronatus Conrad c.
Dalmanites boothi Green
Spirifer medialis Hall c.
Platyostoma cf. euompholoides Conrad
Chonetes sp. cf. C. coronatus Conrad
Chonetes sp. small
Cup coral sp.
Orthonota sp.
Grammysia sp.
Pleurotomaria sp.
Crinoid stem.
"Hamilton in age."

MARINE INVERTEBRATE FOSSILS, MARCELLUS SERIES.

In the Marcellus Series, which has been described on pages 314-329, inclusive, three collections were made by the writer in the Lower Selinsgrove Limestone, belonging in the basal portion of the group. This limestone is dark and shaly with interbedded streaks of black shale in which fossils are often abundant. In the reference cited above, it has already be pointed out that the presence of **Liorhynchus limitare** so near the top of the Oriskany Sandstone in sediments which have been classed as Onondaga by some authorities must either cause the abandonment of this species as the guide fossil of the Marcellus or else must put the Marcellus in direct contact with the Oriskany without any intervening Onondaga. The writer has favored the latter interpretation. Dr. Tilton's description of these three collections is as follows:

"There are collections from three different localities in the Lower Selinsgrove (Marcellus) Limestone.

"One locality is on the head of Cabin Run of Patterson Creek, 0.4 mile northeast of Rodgers School, Mineral County. At this point a dense gray calcareous bed contained **Aviculopecten princeps** Conrad. A very dark shale contained **Buchiola halli** Clarke, **Chonetes (sp. ?), Liorhynchus limitare** Vanuxem, **Nuculites oblongatus Conrad, Bellerophon** sp. ?), and **Phacops rana** Green.

"A second locality is at the point where the Western Maryland Railway crosses the Baltimore and Ohio Railroad just north of Twenty-first Bridge, Allegany County, Maryland (see No. 5 of Twenty-first Bridge Section, page 321). Here a very dark shale is crowded with **Liorhynchus limitare** Vanuxem, with many fragments of **Spirophyton** and contains an occasional **Tentaculites bellulus** Hall and **Nucula bellistriata** Conrad.

"The third location, on the Northwestern Pike 1.7 miles southeast of Burlington and just west of the Beaver Run Anticline, Mineral County, West Virginia, is also in a dark shale, some of which has weathered to a greenish color. The fragments collected contain **Ambocoelia virginiana** Prosser and Kindle, **Chonetes (sp. ?),** and **Aviculopecten princeps** Conrad."

In the Marcellus Series, also, collections from 11 localities were made by Prof. Scheffel and Paul H. Price, principally

in the Lower Selinsgrove Limestone although one of them extends down to the top of the Oriskany Sandstone and some others are in shale that comes entirely above the limestone. The presence of **Liorhynchus limitare** is noted in some of the collections from the Lower Selinsgrove, making a valuable check on the evidence obtained by Dr. Tilton from the collections of the writer. As previously discussed in the stratigraphy of the Marcellus Series there appears to be little doubt that the calcareous zone of this group in Mineral and Grant Counties represents only the Lower Selinsgrove Limestone of eastern Pennsylvania, the member being often split into two well-defined benches. In the type region of the Selinsgrove Limestones the Upper Selinsgrove comes near the top of the Marcellus where only black shale is found in Mineral and Grant Counties.

The identifications made by Dr. Prouty from the collections of Scheffel and Price, together with his comments are given below. A few Onondaga types are noted but the dominance of Marcellus species is quite apparent:

Mineral County; along road leading up hill east of North Branch of Potomac River, 1.2 miles northeast of Keyser and 0.4 mile southeast of Twenty-first Bridge. Collection made in shales just above Lower Selinsgrove Limestone. No section measured. (Labeled 850S, K-1-43, E. R. S., p. 511c):

Ambocoelia umbonata Conrad c.
Phacops rana Green aa.
Rhipidomella sp.
Chonetes cf. coronatus Conrad
Coleolus tenuicinctus Hall ?
Bollia sp.
Phacops sp. close to P. rana, but there seems to be too great distance between posterior border of pygidium and end of center lobe of pygidium.
Stereolasma sp.
Crinoid stem.
"Marcellus in age."

Mineral County; along road leading up hill east of North Branch of Potomac River, 1.2 miles northeast of Keyser and 0.4 mile southeast of Twenty-first Bridge. Elevation, 790′ B. Collection partly in black (Lower Selinsgrove) limestone and partly in associated shale. No section measured. (2 collections here labeled 790B, K-1-43, D. B. R., p. 308; E. R. S., pp. 563 and 513c):

First Collection:

Numerous crushed and distorted shells of what seems to be Probeloceras lutheri Clarke.
Modiomorpha sp.
Loxonema sp. A very slim form probably new species.
Rhipidomella sp.
Styliolina fissurella Hall aa.
Chonetes sp. c.

Aviculopecten sp.
"Selinsgrove Limestone and associated shale. Marcellus fauna."

Second Collection:
Nuculites modulatus Kindle a.
Buchiola halli Clarke aa.
Chonetes sp. (same as locality 1085-1255B-K4, collection No. 2) a.
Orbiculoidea sp.
Ambocoelia umbonata Conrad, very small, aa.
Chonetes cf. scitulus Hall
Styliolina fissurella Hall aa.
Orthoceras subulatum Hall
Cf. Probeloceras lutheri Clarke aa.
Orthoceras cf. scitula Hall
Pholidops hamiltoniae Hall
Anoplotheca cf. acutiplicata Conrad
Cyrtolites metula Hall.
"Marcellus, Selinsgrove Limestone horizon."

Allegany County, Maryland; at Twenty-first Bridge across North Branch of Potomac. Collection in lower portion of Lower Selinsgrove Limestone almost immediately under Western Maryland Railway viaduct which crosses Baltimore and Ohio Railroad. See No. 5 of Twenty-first Bridge Section, page 321. (Labeled 800S, K. 1-33, E. R. S., p. 511c):

Liorhynchus limitare Vanuxem aa. Forms rather gibbous and all very small usually less than ten mm. and many only 5 mm., most shells broken.
Bellerophon sp. Fragments of large form.

"Nearly black, fine-grained limestone, sparkling with minute pieces of thin dark-colored Brachiopod shells, Selinsgrove Limestone horizon. Marcellus fauna."

Mineral County; in road along eastern base of Knobly Mountain on branch of Cabin Run 2.1 miles northeast of Liller and 0.4 mile northeast of Rodgers School. Elevation, 1030′ B. Collection in 10 feet of dark limestone (Lower Selinsgrove). No section measured. (Labeled 1030B, K-4-23, D. B. R., p. 381; E. R. S., p. 578):

Ambocoelia umbonata Conrad a.
Liorhynchus cf. laura Billings
Stereolasma sp.
Phacops rana ? Green, fragments.
Chonetes sp.
Rhipidomella sp.
Palaeoneilo sp.
"Dark limestone, Marcellus horizon, Selinsgrove Limestone."

Mineral County; on Northwestern Pike 1.7 miles southeast of Burlington. Elevation, 880′ B. Probably upper bench of Lower Selinsgrove Limestone. No section measured. (Labeled 880B, K-8-2, D. B. R., p. 304; E. R. S., p. 579):

Ambocoelia umbonata Conrad a.
Phacops rana Green c.
Stereolasma rectum Hall

Chonetes sp.
Loxonema sp. Very slim form.
Liorhynchus laura Billings.
"Marcellus age."

Mineral County; on Northwestern Pike, 0.2 to 0.5 mile northwest of Ridgeville. Elevation, 1085′ to 1255′ B. **Collection No. 2** made in first 4′ of limestone (Lower Selinsgrove) above Oriskany Sandstone and in limy shales below limestone. **Collection No. 3** from lower part of limestone (Lower Selinsgrove) near Oriskany contact. **Collection No. 1** from limestone (Lower Selinsgrove) about 20′ (stratigraphic) above No. 2. These would all apparently be in No. 6 of Ridgeville Section, page 138. (Labeled 1085B-1255B, K-4-51, D. B. R., p. 382; E. R. S., pp. 572-573):

Collection No. 1:
Phacops rana Green
Cf. Anoplia nucleata Hall
Crinoid stem
Stereolasma cf. rectum Hall
Coleolus tenuicinctus Hall
"Dark-gray, calcareous shale, 20′ above Collection No. 2. Marcellus fauna."

Collection No. 2:
Ambocoella umbonata Conrad c.
Buchiola halli Clarke aa.
Tentaculites sp.
Loxonema sp. nov. This form resembles L. hamiltoniae also L. rectistriatum in having numerous and but slightly curved striae, and small apical angle. There are 13 whorls in the shell a little less than an inch in length. The width of shell at last whorl is 6 mm. There are 40 striae to the whorl.
Orthoceras subulatum Hall
Chonetes close to C. vicinus Castelnau
Cyclora sp.
Tropidoleptus carinatus Conrad c.
Styliolina fissurella Hall c.
Productella sp.
Coleolus tenuicinctus Hall a.
Bactrites aciculum Hall a.
Orthoceras close to O. scintella, but differs in having smaller apical angle, slightly greater spacing of sutures and lateral position of siphuncle.
Bollia sp.
Phacops rana Green
Nucula cf. corbuliformis Hall
Nuculites modulatus Kindle
Chonetes sp.
Cf. Pholidops hamiltoniae Hall.
"Slightly calcareous, dark-gray shale just above Oriskany."

Collection No. 3:
Tropidoleptus carinatus Conrad
Nucula corbuliformis Hall
Orthoceras sp.
"Dark-gray argillaceous and calcareous shale from near bottom of limestone near Oriskany contact. Marcellus age."

Mineral County; at foot of bluff just west of New Creek town on west side of New Creek. Collection in Lower Selinsgrove Limestone. Elevation, 995′ B. No section measured. (Labeled 995B, Eg. 6-34, D. B. R., p. 314c; E. R. S., p. 581):

Atrypa reticularis Linnaeus a.
Ambocoelia umbonata Conrad c.
Phacops rana Green aa.
Stereolasma cf. rectum Hall
Panenka sp. nov., close to P. dichotoma Hall
Parodiceras discoideum Conrad
Dalmanites sp.
Camarotoechia sp.
Orthoceras sp.
Nuculites sp. close to N. modulatus Kindle, of Onondaga age.
Anoplia nucleata Hall, Onondaga age c.
Styliolina fissurella Hall aa.
Bollia ungula Jones, Onondaga age
Dalmanella sp.
Anoplotheca sp.

"Dark calcareous shale to light non-calcareous shale, slightly arenaceous. Fossils are all calcareous. Marcellus with some Onondaga species; Marcellus in age."

Grant County, along Lunice Creek in town of Maysville. Elevation, 1285′ to 1305′ B. Collection from shale apparently between the two benches of Lower Selinsgrove Limestone. See No. 7 of Maysville Section, page 176. (Labeled 1285-1305B, Gg. 4-35 and 5-31 and 41, D. B. R., pp. 338c and 385c; E. R. S., pp. 530-531):

Proetus sp.
Phacops rana Green
Ambocoelia umbonata Conrad a.
Cup coral sp.

"Black sandy shale and limestone. Marcellus, Selinsgrove Limestone horizon."

Grant County; at turn of private road up branch of Lunice Creek, 2.7 miles northeast of Petersburg. Elevation, 1330′ B. Collection made in 45′ of shale coming just above Lower Selinsgrove Limestone. No section measured. (Labeled 1330B, Gg. 8-44, D. B. R., p. 372c; E. R. S., pp. 507-508):

In black shale:
Liorhynchus limitare Vanuxem r.
Ambocoelia umbonata Conrad a.
Lingula sp.

In gray shale:
Loxonema hamiltoniae Hall
Ambocoelia umbonata Conrad
Cf. Stereolasma rectum Hall
Coleolus cf. tenuicinctus Hall
Orthoceras sp., like O. subulatum Hall, of Hamilton
Conularia cf. undulatus Conrad
Cf. Spyroceras crotalium Hall
Stropheodonta sp.

Chonetes sp.
Nuculites sp.
"Marcellus in age."

Grant County; in bluff 0.2 mile south of Baltimore and Ohio Railroad Station at Petersburg. Elevation, 945′ B. **Collection No. 1** from Lower Selinsgrove Limestone and interbedded shales. See Nos. 4-8, inclusive, of Petersburg Section, page 322. **Collection No. 2** from shale at base of limestone. See No. 9 of Petersburg Section. (Labeled 945B, P. 2-3 and 23, D. B. R., p. 388c; E. R. S., pp. 503-504):

In shale:
Liorhynchus limitare Vanuxem aa.
Styliolina fissurella Hall aa.

In limestone:
Atrypa spinosa Hall
Phacops rana Green.
"Marcellus Formation."

Grant County; in bluff on north side of South Branch of Potomac, 100 to 300′ downstream from Smith Falls, near mouth of Hoglan Run, 1.5 miles west of Petersburg. Elevation, 995′ B. Collection in 20′ bench of limestone (Lower Selinsgrove). No section measured. (Labeled 995B, Gg. 8-51, D. B. R., p. 342c; E. R. S., pp. 509-511):

Gastropods sp. Many poorly preserved fragments
Bellerophon sp. like species in locality 800S, K-1-33.

"Black sandy shale and limestone, Marcellus, Selinsgrove Limestone."

LOWER DEVONIAN FOSSILS.

In the Lower Devonian the rocks of which have been described on pages 330-356, inclusive, there are abundant marine invertebrate fossils in both the Oriskany Sandstone and the Helderberg Limestone. In the Oriskany they may be collected with ease since the stone breaks readily under the blow of a hammer but in the Helderberg it is often well-nigh impossible to remove some of the best specimens from the compact limestone in which they appear.

MARINE INVERTEBRATE FOSSILS, ORISKANY SANDSTONE.

In the Oriskany Sandstone, the description of which is published on pages 330-9, inclusive, great numbers of fossils are found, there being occasional bedding-planes in the Ridgeley Sandstone Member on which a hammer can scarcely be struck without mutilating some of them. **Spirifer arenosus,** the guide fossil of the Oriskany, has been noted in nearly all the collections.

In Mineral and Grant Counties a few collections were made in the Oriskany in order to show the continuity of its

fossil life across the area, with but little expectation of finding anything new, since the Potomac phase of the formation has been exhaustively studied by the Maryland Survey, as described in its volumes on the Devonian. Two small collections were made by the writer, one consisting of a single shell and the other principally of a large museum slab, the report of Dr. Tilton on them being as follows:

"At the top of Queen's Point, a promontory in Allegany County, Maryland, overlooking North Branch of Potomac River just east of McCool and just north of Keyser:

"**Spirifer arenosus** Hall. There is but one specimen, in brown sandstone. This is a guide fossil of the Oriskany Sandstone."

"In the public road along Patterson Creek 0.2 mile north of Williamsport, Grant County, West Virginia, Fragments of a brown sandstone, and a large slab 12" x 19":

"**Spirifer intermedius** Hall. One shell.
"**Rensselaeria (Beachia) suessana** Hall. One shell.
"Four fragments too small for identification.

"The above named fossils mark an outcrop of the Ridgeley Sandstone (Oriskany), top of Lower Devonian."

In the Oriskany, also, 8 collections were made by Prof. Scheffel and Paul H. Price. All of these appear to be in the Ridgeley Sandstone Member, there being no record of anything from the Shriver Chert which lies at the base of the group. Dr. Prouty's identifications, together with his brief comment, are as follows:

Mineral County; in road along eastern slope of Knobly Mountain, just southwest of Ridgeley and southwest of Cumberland. Collection probably made in Ridgeley Sandstone Member. No section measured. (Labeled 700P, Fb. 6-34, D. B. R., p. 325; E. R. S., p. 583):

Spirifer murchisoni Castelnau aa.
Spirifer arenosus Conrad c.
"Oriskany in age."

Mineral County; at stone quarry in gap of New Creek Mountain, 1.4 miles northeast of New Creek town and 0.2 mile east of New Creek. Elevation, 925′ B. Collection in lower portion of sandstone near Helderberg contact. See description of quarry, page 666. (Labeled 925B, Eg. 6-25, D. B. R., p. 307c; E. R. S., p. 564):

Spirifer arenosus Conrad
Rensselaeria ovoides Castelnau a.
Stropheodonta (Leptostrophia) magnifica Hall c.
Rhipidomella cf. musculosa Hall
Platyceras sp., large form
Actinopteria sp.
"Oriskany in age."

Mineral County; at stone quarry on east side of New Creek, 0.8 mile southwest of Claysville. Elevation, 1140′ B. See description of quarry, page 667. (Labeled 1140B, Eg. 6-51 and 52, D. B. R., p. 380; E. R. S., pp. 566-567):

Spirifer arenosus Conrad a.
Spirifer murchisoni Castelnau a.
Hipparionyx proximus Vanuxem r.
Rensselaeria, close to circularis (Schuchert)
Orbiculoidea sp.
Rensselaeria ovoides Eaton c.
Anoplotheca sp.
Anoplotheca fimbriata Hall aa.
Chonostrophia complanata Hall
Tentaculities cf. elongatus Hall
Platyceras reflexum Hall
Platyceras sp.
Cf. Rhipidomella musculosa Hall
Meristella sp.
"Oriskany in age."

Grant County; in road along east side of Patterson Creek, 0.2 mile north of Williamsport. Elevation, 970′ L. Collection in Ridgeley Sandstone Member. No section measured. (Labeled 970′ L., Gg. 3-34, D. B. R., p. 369, E. R. S., p. 551):

Spirifer murchisoni Castelnau aa.
"Oriskany in age."

Grant County; in bluff along Patterson Creek, 0.3 mile northeast of Medley. Elevation, 1030′ B. Collection in Ridgeley Sandstone Member. No section measured. (Labeled 1030B, Gg. 3-52, D. B. R., p. 367; E. R. S., pp. 542-543):

Rensselaeria ovoides Eaton aa.
Spirifer arenosus Conrad a.
Platyceras gebhardi Conrad c.
Cf. Rhipidomella musculosa Hall c.
"Oriskany in age."

Grant County; on Lunice Creek just west of Maysville. Elevation, 1320′ B. Collection in upper portion of Ridgeley Sandstone Member. No section measured. (Labeled 1320B, Gg. 4-35, D. B. R., p. 358c; E. R. S., pp. 556-557):

Spirifer arenosus Conrad aa.
Rensselaeria ovoides Eaton a.
Tentaculites cf. elongatus Hall r.
Platyceras sp. c.
Meristella sp. c.
Stropheodonta (Leptostrophia) cf. magnifica Hall
"Oriskany in age."

Grant County; on Lunice Creek, 0.2 mile northwest of Brick Church and west of Cosner Gap. Collection from face of long cliff made by Ridgeley Sandstone Member. See No. 10 of Maysville Section, page 176. (Labeled 1570S, Gg. 4-23, E. R. S., p. 541):

Spirifer arenosus Conrad a.
Spirifer murchisoni Castelnau a.
Meristella sp.
Rensselaeria sp.
Leptaena rhomboidalis Wilckens c.
Rensselaeria cf. cayuga Hall & Clarke
Meristella sp.
Streptelasma ? sp.
Algae ?
"Oriskany in age."

Hardy County; on north side of South Branch of Potomac River at east end of gap through Patterson Creek Mountain, 0.2 mile north of Welton. Collection from upper part of Ridgeley Sandstone Member. No section measured. (Labeled 905B, Gg. 9-51, E. R. S., p. 501):

Spirifer arenosus Conrad aa.
Rensselaeria ovoides Eaton aa.
Spirifer murchisoni Castelnau a.
Hipparionyx proximus Vanuxem r.
Crinoid sp. c.
"Oriskany in age."

MARINE INVERTEBRATE FOSSILS, HELDERBERG LIMESTONE.

In the Helderberg Limestone, which is described on pages 339-356, inclusive, extensive collections have been made by members of the Maryland Survey in the quarries of the Standard Lime and Stone Company near Keyser, and also at other localities along the Maryland-West Virginia State Line, as detailed in the Devonian Volume of that Survey. Some of the essential lists from these collections have been republished on pages 349-354 of this Report. Four fragmentary collections, two of which consist of single specimens only, were made by the writer in the course of stratigraphic studies, Dr. Tilton's report on them being as follows:

"A single specimen was obtained from the steep bluff of Knobly Mountain just south of Cedar Cliff, Mineral County, West Virginia (see No. 4 of Cedar Cliff Section, page 134). It is a dense gray limestone an inch thick, a mass of calcareous pebbles and fragments of fossils, among which worn segments of crinoid stems and bryozoan fragments are very numerous. Six forms of Bryozoa are noted, of which **Fenestella cumberlandica** Ulrich and Bassler and **Cladopora (rectilineata ?)** Simpson (considered a coral) are abundant. These forms are restricted to the Keyser Member of the Helderberg. **Rhynchospira globosa** Hall is present, a form that is reported from the Tonoloway (Bossardville) to the New Scotland. A portion of a pelecypod is also found.

"The general character of the rock is characteristic of the Keyser Member of the Helderberg, and with this the slight determination of species agrees. An endeavor was made to clean the surface of the specimen, but no sections of the rock were made.

"A second collection was made from limestone outcropping at the surface of Core Test No. 4 (No. 4 on Map II) of the Cumberland Portland Cement Company at elevation 1360′ B. near the summit of Knobly Mountain 0.8 mile east of Ackerman, Mineral County, West Virginia, and 0.2 mile northeast of the quarry of that company.

"The chief question here is, are the specimens from the Keyser, or from the Bossardville (Tonoloway)? The specimens are silicified by deposition of silica inside the shells and by replacement of the shells. The matrix is largely calcareous, so that treatment by acid leaves the shells exposed, most of which are fragments.

"**Rhynchospira globosa** Hall. On one surface about five centimeters by eight centimeters fragments of eight shells are noted; they appear of nearly equal abundance in the other fragments. The best specimen is slightly longer than wide and shows the angular plications, twelve in number, two of which, in the center, are very slightly depressed. The beak and hinge area are not visible in this specimen but they are visible in other specimens.

"Rhynchospira is a type common in both the Silurian and the Devonian. It is listed as found in both the Keyser and the New Scotland; while in the Bossardville (Tonoloway) of the Pawpaw-Hancock Quadrangles there are three species of Rhynchospira listed. To this extent the rock seems allied with the Bossardville.

"**Leperditia altoides** Weller. The smooth oval shells, without surface markings and of the right proportions are judged to be of the species named.

"This species has been reported doubtfully from the Bossardville along with several other species of Ostracoda, and reported certainly from the Keyser of Maryland and New Jersey. Their abundance in the limestone at hand favors the Bossardville rather than the Keyser.

"**Loxonema fitchi** Hall. The best specimen is a cast of four whorls, with no evidence of angles and without umbilicus. It is therefore classed with Loxonema rather than with Hormatoma. In form it agrees with Hall's description and figure. It is to be regretted that the specimens are not perfect, for Loxonema is chiefly Devonian in its affinities, while Hormatoma is Silurian. Ulrich has listed Hormatoma as in the Bossardville (Tonoloway) of the Pawpaw-Hancock Quadrangles while in the Maryland report on the Devonian Loxonema fitchi is listed under range not determined. In New York it is listed from the Rondout to Becraft inclusive.

"**Pleurotomaria labrosa** Hall (?). The single imperfect shell corresponds in general outline with Pleurotomaria, but details are absent. The specimen is unlike any other species reported from near this horizon. Pleurotomaria labrosa is not reported from the Bossardville (Tonoloway) of the Pawpaw-Hancock Quadrangles but is reported from the New Scotland of Maryland and from the New Scotland and Becraft of New York.

"**Bellerophon auriculatus** Hall. The one imperfect individual found shows a very faint carina, less than what seems to be described for B. helderbergiae. Bellerophon is not reported from the Bossardville (Tonoloway) of the Pawpaw-Hancock Quadrangles. B. auriculatus is reported from the Cobleskill of New York and from the Helderberg at Cumberland. B. helderbergiae Swartz is reported from the Keyser formation in Maryland.

"**Meristella arcuata** Hall? This is a fragment of a smooth shell like Meristella, a shell that is not reported from the Bossardville (Tonoloway) of the Pawpaw-Hancock Quadrangles, but is reported from the New Scotland and Becraft of Maryland and the Coeymans of New York.

"The beds at Ackerman are evidently transition beds, but the fossils found do not place the beds definitely in either the Bossardville or the Keyser. A more extensive set of specimens is needed.

"In Maryland the Deckers Ferry of New Jersey is correlated with the Keyser, the beds beneath (Tonoloway) corresponding with the Bossardville of Pennsylvania and New Jersey. In Maryland the Bossardville is 'a fissile platy, almost unfossiliferous limestone' as in New Jersey. These beds at Ackerman are therefore more closely related to beds in the lower part of the Keyser than to beds in the Bossardville. They are not related to beds in the higher portions of the Keyser because of a complete absence of Tentaculites gyracanthus. For the same reason they can not be referred to the Manlius (the Rondout not being recognized in Maryland)."

"A third collection was made in a high gap of Knobly Mountain, 0.7 mile north of Rodgers School and 3 miles southward from Keyser, Mineral County, at elevation 1710′ B.

"**Stromatopora constellata** Hall. The single specimen submitted is a concentric mass of calcium carbonate somewhat hemispherical in shape, about six inches across the top and four inches thick. It is so weathered that none of the (nodose?) surface is left. There are, however, small rounded surfaces of zooidal pores that seem related to mammulae about one and a half millimeters apart from which there are radiations suggesting astrohezae. The concentric arrangement and the latilaminae are evident.

"Stromatopora constellata is reported found throughout the Helderberg of New York and from the Keyser of Maryland."

"A fourth collection was made at the mouth of the Peacock Cave, on a spur of Cave Mountain in the Smokehole Settlement of Grant County 7 miles southwest of Petersburg, at elevation 1755′ B.

"The specimens consist of silicified fossils in a gray calcareous and arenaceous matrix.

"**Spirifer macropleura** Conrad. There are eight fragments of this, the guide fossil to the New Scotland horizon.

"**Spirifer perlamellosus** Hall. There is but one specimen of this, a fossil widely distributed in the Helderberg.

"**Schuchertella woolworthana** Hall. There are four fragments, each showing the distinctive surface markings.

"**Leptaena rhomboidalis** Wilckens. There are two specimens. The species ranges from the Clinton to the upper Helderberg.

"**Meristella arcuata** Hall. There is but one specimen: an impression of the larger part of a dorsal valve.

"**Streptelasma strictum** Hall. There is about half of a specimen so broken as to give a vertical section, nicely silicified. In this half of the coral there are sixteen primary septae where the diameter is fifteen centimeters, all these primaries reaching the central portion where they coalesce around a center that contains a coarse vesicular arrangement of plates. Between these primary septae thin sharp ridges of secondary septae are visible on the thecum. The outside of the thecum is without annulations, but has distinct striations.

"A few fragments of **crinoid stems.**

"All the above specimens agree in referring the strata to the New Scotland beds."

Eight collections from the Helderberg, also, were made by Prof. Scheffel and Paul H. Price, ranging from the New

Scotland Chert down through the Coeymans and Keyser Members. Dr. Prouty's identifications and comment on these fossils are as follows:

Allegany County, Maryland; on north side of North Branch of Potomac River in Baltimore & Ohio Railroad cut just east of Potomac Station. Probably middle portion of Helderberg. See No. 4 of Potomac Section, page 136. (Labeled 685S, Fb. 8-5, E. R. S., p. 586):

Favosites helderbergiae Hall
Stropheodonta cf. coeymanensis Swartz.

"Dark-gray, fine-grained, rather pure limestone. Of probable Coeymans age."

Mineral County; near eastern end of western quarry of Standard Lime and Stone Company on south side of North Branch of Potomac River one-half mile east of Keyser. Probably No. 5 of Limestone Run Section, page 139. (Labeled 805S, K. 1-43, E. R. S., p. 587; Collection No. 1):

Collection No. 1:

Stropheodonta cf. bipartita Hall
Spirifer vanuxemi Hall. (The material in which this fossil occurs is lighter colored and does not seem the same as the material in which the other fossils occur and probably belongs to the Bossardville).
Cf. Hindia spheroidalis Duncan
Favosites helderbergiae var. praecedens Schuchert
Fenestella cf. cumberlandica
Camarotoechia sp.
Meristella sp.

"Dark-gray, compact to finely crystalline limestone. Basal Keyser in age."

Mineral County; on Limestone Run, 0.8 mile southeast of Keyser, starting with Helderberg Limestone and traversing southeastward on rise of measures. Collection No. 1 probably bottom of Helderberg; Collection No. 2 probably Bossardville; Collection No. 3 probably base of Bossardville; Collection No. 4 probably in Rondout. No section measured. (All labeled 825-850S, E. R. S., pp. 504c-506c). (For Collections No. 2 and 3 see Bossardville and for No. 4 see Rondout):

Collection No. 1:

Hindella congregata var. aa.
Hormatoma sp. c.
Leperditia sp.

"The dark-gray crystalline limestone encloses thin fragments of very fine textured, dark-gray limestone (edgewise conglomerate). It is probably the base of the Keyser."

Mineral County; in stone quarry at gap in New Creek Mountain, 1.4 miles northeast of New Creek town and 0.2 mile east of New Creek. Elevation, 925′ B. No section measured. (Labeled 925B, Eg. 6-25, D. B. R., p. 307c; E. R. S., p. 565):

Leptaena rhomboidalis Wilckens aa.
Atrypa reticularis Linnaeus

Spirifer perlamellosus Hall ?
Stropheodonta beckii Hall a.
Schuchertella sp.
Dalmanella cf. clarki Maynard
Trematospira ?
Rensselaeria subglobosa var. avus Schuchert
Rhipidomella sp.
Spirifer cf. macropleura Conrad.

"Dark, grayish-blue, somewhat impure (argillaceous), finely crystalline limestone. Some layers are calcareous, argillaceous sandstones. Seems to be New Scotland in age."

Grant County; in road up branch of Patterson Creek just east of Williamsport. Elevation, 1030′ to 1075′ B. **Collection No. 1** from lower portion, **No. 2** from middle, and **No. 3** from top. No section measured. (Labeled 1030-1075B, Gg. 3-34, D. B. R., p. 448; E. R. S., p. 530):

"Gray limestone and light-gray chert."

Collection No. 1:

Stropheodonta close to S. bipartita Hall
Aulipora sp.
Cladopora sp.
Camarotoechia sp.
Tentaculites cf. gyracanthus Eaton
Meristella sp.

"Keyser in age."

Collection No. 2:

Stropheodonta cf. veristriata Conrad aa.
Chonetes sp. aa.

"Keyser in age."

Collection No. 3:

Crinoid stems. Practically whole rock made up of stems.

"Coeymans? in age."

Grant County; on Lunice Creek at east end of Mays Gap just west of Maysville. Elevation, 1330′ B. Collection from New Scotland Chert member. No section measured. (Labeled 1330B, Gg. 4-35, D. B. R., p. 358c; E. R. S., pp. 558-559):

Spirifer cf. concinnus Hall a.
Rhynchospira cf. formosa Hall a.
Strophonella punctulifera Conrad a.
Strophonella headleana Hall a.
Leptaena rhomboidalis Wilckens r.

"Fine to medium crystalline limestone, very fossiliferous and having some rather angular, somewhat laminated black chert with streaks of calcite. Seems to be New Scotland in age."

Grant County; on north side of Lunice Creek, about 150′ west of Brick Church and west of Cosner Gap. Collection from New Scotland Chert member. See No. 12 of Maysville Section, page 176. (Labeled 1574S, Gg. 4-33, E. R. S., p. 540):

Leptaena rhomboidalis Wilckens
Spirifer perlamellosus Hall

Eatonia sp.
Meristella sp.
Schuchertella sp.
Crinoid stems.

"Medium-gray and medium-fine grained limestone with occasional stringer of chert. Seems to be New Scotland in age."

Hardy County; on north side of South Branch of Potomac River at east end of gap through Patterson Creek Mountain, 0.2 mile north of Welton Station. Elevation, 905′ B. Collection from New Scotland Chert member. No section measured. (Labeled 905B, Gg. 9-51, D. B. R., p. 365c; E. R. S., p. 502):

Dalmanella cf. perelegans Hall
Spirifer perlamellosus Hall
Zaphrentis sp.
Spirifer close to S. gordoni Schuchert from the Oriskany.
Crinoid stem.

"Alternate gray chert and limestone bands. New Scotland in age."

SILURIAN FOSSILS.

In the Silurian, the rocks of which have been described in Chapter XIV, pages 357-424, inclusive, the fossil marine life shows many variations that reflect to a striking degree the changes that must have occurred during that period. In the Salina Formation, embracing, in Mineral and Grant Counties, the Bossardville, Rondout, and Bloomsburg Groups, the fauna is limited mainly to ostracods, with occasional Eurypterids and a few other forms that persisted through many succeeding stages of generally unfavorable environment. In the Niagara and Clinton, fossils are much more abundant than in the Salina but relatively fewer and much less varied than the rich life which prevailed both in Ordovician and Devonian time, ostracods and allied types being the more common. In the three Medina groups the waters were almost totally barren, not a single fossil having been observed or collected from these in either county, although the presence of Arthrophycus and possibly Scolithus in the White Medina is believed to be probable on account of their reported occurrence in adjoining areas.

The significance of the fossil life of the Silurian, especially as it pertains to the Devonian-Silurian boundary, has been discussed at some length in the Introduction to Chapter XIV and has been further elaborated in the sections on "Fossil Life" under the descriptions of the various groups. The following pages contain the detailed record of collections and identifications made within or near the area of this Report.

MARINE INVERTEBRATE FOSSILS, BOSSARDVILLE LIMESTONE.

In the Bossardville Limestone, described on pages 377-383, inclusive, remarks have already been made concerning the general prevalence of **Leperditia alta,** which had successfully persisted through several groups but which apparently disappeared at the close of this group, being succeeded by the variation **Lepeditia altoides** in the more favorable marine environment of the Lower Devonian. Another circumstance of much importance is the presence of Eurypterus fragments, which, although much limited in their occurrence, apparently justify the correlation of the Bossardville as part of the Salina Formation of New York State.

In Mineral and Grant Counties no fossils were collected by the writer in the Bossardville but specimens were secured by Prof. Scheffel and Paul H. Price from four localities reported as follows by Dr. Prouty, the title **Bossardville** being inserted by the writer to indicate the usage of the West Virginia Survey:

Mineral County; in interval between twin quarries of Standard Lime and Stone Company on south side of North Branch of Potomac River one-half mile east of Keyser. See No. 6 of Limestone Run Section, page 139. (Labeled 800S, K. 1-43, E. R. S., p. 587, Collection No. 2):

Cf. Spirifer corallinensis Grabau
Hormatoma sp. very small
Leperditia alta var. a.
Leiopteria sp.
Cf. Welleria obliqua U. & B. c.
Dizygopleura close to concentrica U. & B.
Orthoceras sp. Minute form about the size of a hair.
Cf. Eurypterus sp. Fragment of carapace.
"Seems to be Bossardville (Tonoloway) in age."

Mineral County; on Limestone Run, about one mile southeast of Keyser. **Collection No. 2** probably Bossardville; **Collection No. 3** probably base of Bossardville. No section measured. (Labeled 825-850S, E. R. S., pp. 504c-506c). (For collection No. 1 see Helderberg and for No. 4 see Rondout):

Collection No. 2:
Leperditia mathewsi U. & B. a.
Leperditia elongata close to var. willsensis U. & B.
Cf. Hindella congregata Swartz r.
Homeospira sp. aa.
"Bossardville (Tonoloway) in age."

Collection No. 3:
Cf. Schuchertella rugosa Swartz aa.
Leperditia cf. mathewsi U. & B.
Sphaerocystites sp.
Spirifer sp.
"Probably toward base of Bossardville (Tonoloway)."

Grant County; along road up branch of Patterson Creek, 0.3 mile east of Williamsport. Elevation, 1075′ to 1145′ B. Collection across outcrop. No section measured. (Labeled 1075-1145B, Gg. 3-34, D. B. R., p. 448; E. R. S., pp. 547-549):

Spirifer vanuxemi Hall aa.
Leiopteria sp.
Bryozoa sp.
Spirifer sp.
"Bossardville (Tonoloway) in age."

Grant County; at foot-bridge across Lunice Creek between Brick Church and Cosner Gap. See No. 14 of Maysville Section, page 176. (Labeled 1550S, Gg. 4-33, E. R. S., pp. 538-539):

Camarotoechia tonolowayensis Swartz aa.
Modiolopsis leightoni Williams
Leperditia alta Conrad

"Is probably Bossardville (Tonoloway). It might be top of Rondout (Wills Creek)."

MARINE INVERTEBRATE FOSSILS, RONDOUT WATERLIME.

In the Rondout Waterlime, the description of which is published on pages 384-391, inclusive, where its correlation with the Rondout of New York State is discussed, there being further remarks in the Introduction to Chapter XIV, the scanty fauna consists mainly of ostracods, together with a few other forms. No collections were made by the writer but specimens from four localities were secured by Prof. Scheffel and Paul H. Price, reported by Dr. Prouty in the following lists. As in the case of the Bossardville Dr. Prouty has followed the classification of the Maryland Survey in calling the formation "Wills Creek" but the name **Rondout** has been substituted by the writer to comply with the West Virginia nomenclature, as determined by the State Geologist (I. C. White) to be consistent with the well-established rules of priority in universal use.

Allegany County, Maryland; in Baltimore & Ohio Railroad cut on north side of North Branch of Potomac River, 0.2 mile east of Potomac Station. Elevation, 690′ B. **Collection No. 1** is 530′ west of western cement mine opening; **collection No. 2** is 150′ east of eastern cement mine opening; **collection "A"** is taken between Nos. 1 and 2. See Potomac Section, Nos. 6-13, page 136; think it possible that collection No. 1 may reach up into Bossardville and No. 2 down into Niagara (No. 18 of section), if distances are correctly reported. (Labeled 690B, Fb. 8-5, D. B. R., p. 284c; E. R. S., p. 585):

Collection No. 1:
Leperditia alta Conrad c.
Orbiculoidea ? sp.
Hormatoma sp.
Ramose bryozoa sp?

Fragment of smooth brachiopod sp. ?
"Probably upper Rondout, but fossils not very diagnostic."

Collection No. 2:

Beyrichia mesleri U. & B. a.
Dizygopleura acuta U. & B.
Dizygopleura, close to swartzi
Kloedenella, close to gibberosa
Kloedenella, close to subovata
Bythocypris sp.
Eukloedenella, close to simplex
Leiopteria sp.
Camarotoechia sp., close to C. andrewsi Prouty
Dalmanella, close to D. elegantula Dalman.
"This is lower Rondout in age."

Collection A:

Ramose Bryozoa in great numbers constituting a large percentage of the rock; can not determine the form.
"Fossils are not diagnostic but position between Nos. 1 and 2 would make it Rondout."

Mineral County; in eastern of twin quarries of Standard Lime and Stone Company on south side of North Branch of Potomac River one-half mile east of Keyser. See No. 7 of Limestone Run Section, page 139. (Labeled 795S, K. 1-43, E. R. S., p. 587):

Bryozoa sp.
Small needle-like cavities ?
"Fauna does not aid in classification. Is probably Rondout."

Mineral County; on Limestone Run about 1 mile southeast of Keyser. **Collection No. 4** probably in Rondout. No section measured. (Labeled 825-850S, E. R. S., pp. 504c-506c). (For Nos. 1 and 2 at this locality see Helderberg and for No. 3 see Bossardville):

Collection No. 4:

Leperditia elongata var. willsensis aa.
"Rondout in age."

Grant County; along road up branch of Patterson Creek, 0.5 mile east of Williamsport. Collection from upper portion of Rondout. No section measured. (Labeled 1125S, Gg. 3-34, E. R. S., p. 546):

Leperditia alta Conrad aa.
Leperditia altoides var. marylandica U. & B. c.
Leperditia elongata var. willsensis U. & B. c.
Kloedenia longula U. & B. c.
Zygobeyrichia incipiens U. & B. c.
Camarotoechia close to C. andrewsi Prouty a.
Meristina sp. very small form.
"This is Rondout in age."

Grant County; along road up branch of Patterson Creek, 0.6 mile east of Williamsport. Elevation, 1140' B. Collection from lower portion of Rondout. No section measured. (Labeled 1140B, Gg. 3-34 and 44, D. B. R., p. 447; E. R. S., pp. 544-545):

Leperditia sp.
Hormatoma sp.
Cf. Tetrameroceras, something like T. cumberlandicus Swartz.
"Fossils not diagnostic, probably Rondout."

MARINE INVERTEBRATE FOSSILS, BLOOMSBURG RED SHALE.

In the Bloomsburg Red Shale, which has been described on pages 391-8, inclusive, fossils were found at one locality in the Williamsport Sandstone Member. A collection made by the writer at this place is described as follows by Dr. Tilton:

"Three pieces of brownish sandstone and a small piece of shale were obtained in a public road on the western side of Knobly Mountain 1.2 miles northwest of Ridgeville, Mineral County, West Virginia. The sandstone is three-eighths of an inch thick. Both surfaces of it are dotted with concretions of hematite of all sizes up to a third of a millimeter in diameter. The small grains are spheroidal, the larger ones reniform that on breaking reveal concentric structure. Some are solid and some have siliceous center. With these are some irregular sheets of hematite.

"The specimen of shale contains an imprint of a portion of a fossil too incomplete for identification.

'Leperditia alta Conrad. The sandstones are dotted with Leperditia shells that are as large as seven millimeters in length and five in height, smooth and with rounded ends. This corresponds to L. alta (Conrad).

"The sandstone also contains many branching plant-like forms that are four millimeters in diameter, that possibly may belong to the same genus as plant forms found in the Niagara: Buthotrephis.

"This sandstone is totally lacking in Bollia lata Vanuxem and in the Kloedenia-like forms so exceedingly abundant in the 'Fossil Ore Horizon' of the Clinton; but the fossil content of the sandstone is not such as to definitely distinguish this bed from the Niagara. This must be done from position and character of beds rather than from the fossils above named."

Accordingly at the same locality, described in a slightly different way, a more extensive collection was made by Prof. Scheffel and Paul H. Price on which the report of Dr. Prouty is as follows:

Mineral County; along road on west side of Knobly Mountain, 1.3 miles southeast of New Creek town and just northwest of residence of D. A. Arnold. Elevation, 1380′ B. Collection from 0′ 4″ to 0′ 5″ zone of a 15′ sandstone (Williamsport) coming in red shales between Rondout and Niagara Limestones. No section measured. (Labeled 1380B, Eg. 6-45, D. B. R., p. 310c; E. R. S., p. 571):

Lingula sp.
Leperditia alta
Modiolopsis sp.
Cornulites sp.
Homeospira close to H. evax var. marylandica Prouty.
"Bottom of Bloomsburg Sandstone."

MARINE INVERTEBRATE FOSSILS, NIAGARA LIMESTONE.

In the Niagara Limestone, which is described on pages 398-404, inclusive, there is an abundant marine fauna composed of only a comparatively few species, several of which are ostracods. In this Report the Niagara has been defined as including all the rocks between the Bloomsburg Red Shale and the Clinton in the belief that they correlated with the original Lockport and Rochester stages comprised in the Niagara of New York State. In the recent Silurian Volume of the Maryland Survey, however, the Niagara has been extended downward to include the Clinton and abbreviated upward so that the McKenzie Formation, which without much doubt is equivalent to part of the beds correlated as Niagara in this Report, is made the lower formation of the "Cayugan Series," although the statement is made by Dr. Swartz (page 204) that the Rochester and McKenzie can not be differentiated by physical aspect.

The writer made two small collections of fossils from the Niagara which are described as follows by Dr. Tilton:

"**Near Falls P. O.:** Pieces of a blue limestone one inch thick were obtained from North Fork of Patterson Creek, 1 mile northwest of Falls Post-Office, Grant County, West Virginia. The limestone contains an abundance of **Rhynchonella neglecta** Hall, characteristic of the Niagara, and a few fragments of a gastropod (eight) that seem to correspond to **Strophostylus cyclostomus** Hall. There are irregular lines or patches reaching down into the limestone and spread out indefinitely on the surface of it that may be some species of **Buthotrephis.**

"**Near Ridgeville:** The specimens from the road passing northwestward down Knobly Mountain, 1¼ miles northwest of Ridgeville, Mineral County, West Virginia, are a bluish limestone containing numerous impressions and casts of brachiopods that give the stratum as a whole a concretionary or fragmental appearance. Some of the indefinite forms suggest Whitfieldella and some Rhynchonella, but they are too imperfect for identification excepting a few of the Whitfieldella. Three specimens of Orthoceras are present. Scattered through the limestone are numerous minute dark bodies that are shells of Ostracoda.

"**Leperditia faba** Hall. Some forms are 1.6 millimeters long, 1 mm. high, straight hinge line, valve smooth, rounded ends, corresponding to L. faba Hall.

"**Beyrichia moodeyi** Ulrich and Bassler. Some forms are ⅔ mm. long, and about the same in height, with deep sulci dividing the smooth surface into three unequal lobes. The marginal borders are not found exposed. In all other respects the form appears to correspond to B. moodeyi U. and B.

"**Kloedenia (sp. ?).** Forms with smaller sulci correspond to Kloedenia.

"Other forms are present without definite characteristics wherewith to classify them. Some are obovate and smooth. Some are

nearly circular and smooth. In no case is it possible to tell whether the shells overlap and whether teeth are present, at least without microscopic sections of the rocks, which at the present time it does not seem advisable to make.

"**Orthoceras simulator** Hall. One specimen increases from 20 to 30 mm. in diameter in a distance of 50 mm. of length. Apparently the surface is smooth, not annulated. The specimen is too imperfect for evidence with reference to fluting and striation. The septa are 5 mm. apart, reaching to a large central siphuncle about 5 mm. in diameter. Such a description corresponds to a large form of Orthoceras simulator (Hall), except that the siphuncle here found is much larger than that illustrated by Hall. As the septa and shell also appear unduly thick it is thought the enlargement is due to manner of replacement.

"**Orthoceras undulatum** Hall ? A second specimen of Orthoceras is less perfect than the first. It is 60 mm. long, 45 mm. wide, much flattened, with faint indications of undulations and of septa each 5 mm. apart, with no evidence of other surface markings nor of siphuncle. This suggests O. undulatum Hall, the width of the shell compared to distance between septa being due to excessive flattening. No evidence of the interior of the shell is preserved.

"**Orthoceras (sp. ?)**. An impression of a portion of a shell has five septa-like markings in the space of a centimeter.

"**Whitfieldella cylindrica** Hall. There are three specimens of which the outlines preserved are sufficient to make it seem certain that the forms are those of the species named.

"Range of Recognized Species, Niagara Limestone.

Species.	Oneida and Richmond.	Medina.	Clinton.	Niagara.	Salina.	Cobleskill.	Rondout.	Manlius.
Whitfieldella cylindrica Hall	.....	.....	*	*	.....	.....	.....	.....
Orthoceras simulator Hall	.....	.....	.....	*	.....	.....	.....	.....
Orthoceras undulatum Hall ?	.....	.....	.....	*	.....	.....	.....	.....
Leperditia faba Hall	.....	.....	.....	*	.....	.....	.....	.....
Beyrichia moodeyi Hall	.....	.....	.....	*	.....	.....	.....	.....

"In the above list all are recorded as in the Niagara. Beyrichia moodeyi Hall is mentioned in the Pawpaw-Hancock Folio and quoted in the West Virginia Report on Jefferson, Berkeley, and Morgan Counties as present in the McKenzie (Niagara), but Grabau and Shimer list it as found in the Monroan of West Virginia, the Monroan being classed as Silurian above the Niagara."

In the Niagara, also, collections were made from five localities by Prof. Scheffel and Paul H. Price. In reporting these fossils Dr. Prouty has evidently followed the nomenclature and usage of the Silurian Volume of the Maryland Survey. As previously explained, the McKenzie and Rochester appear to be the same as the Niagara of this Report, although a part of the Maryland Rochester may be slightly older. The lists are as follows:

Mineral County; in road which passes northwestward down Knobly Mountain, 1.2 miles southeast of New Creek town and 0.2 mile northwest of residence of D. A. Arnold. Elevation, 1365′ to 1380′ B. Collection presumably across outcrop which is 385 feet (stratigraphic) thick. No further details recorded. (Labeled 1365-1380B, Eg. 6-45, D. B. R., p. 310c; E. R. S., p. 570):

Homeospira evax var. marylandica Prouty aaa.
Eukloedenella sp.
Modiolopsis sp.
Hormatoma sp.

"Dark-gray, compact limestone; many small pelecypods, ostracods, etc., Niagara (McKenzie) in age."

Grant County; along road up North Fork of Patterson Creek, 1 mile northwest of Falls and east of Greenland Gap. Elevation, 1390′ B. See No. 12 of Falls Section, page 174. (Labeled 1390B, Gg. 2-43, D. B. R., p. 374; E. R. S., pp. 532-533):

Leiopteria sp. Prouty, McKenzie (Sil. Rept., Md. Geol. Survey, pl. 28, Fig. 26) a.
Actinopteria sp. aa.
Ramose bryozoa
Nucula sp. aa.
Worm boring in sandstone looks like Arthrophycus
Orthoceras sp.

"Somewhat ferruginous and rather siliceous sandstone; in places very thin bedded and looks like it has been formed along beach or in reach of undertow at least. Niagara (McKenzie) in age."

Grant County; on Lunice Creek 1 mile northwest of Maysville and just east of Cosner Gap. Elevation, 1430′-1445′ B. **Collections Nos. 1, 2, and 3** in descending order from thin-bedded limestones of lower portion of Niagara. **Collection No. 4** from upper portion of Clinton, including Fossil Ore Horizon. **Collection No. 5** from Iron Sandstone in basal Clinton. No section measured. (Labeled 1430-1445B, Gg. 4-35 and 34, D. B. R., p. 357c; E. R. S., pp. 526-529). (For Nos. 4 and 5 see Clinton):

Collection No. 1:

Reticularia bicostata var. marylandica Prouty c.
Whitfieldella sp.
Homeospira evax var. marylandica Prouty a.
"Lower Niagara (McKenzie) in age."

Collection No. 2:

Camarotoechia neglecta Hall c.
Atrypa reticularis Linnaeus c.
Whitfieldella marylandica Prouty aa.
Dalmanites limulurus Green c.
Homalonotus delphinocephalus Green r.
Stropheodonta corrugata Conrad c.
Drepanellina clarki U. & B. c.
Pholidops squamiformis Hall r.
"Lower Niagara (Rochester)."

Collection No. 3:

Atrypa reticularis Linnaeus c.
Camarotoechia neglecta Hall aa.
Stropheodonta corrugata Conrad aa.
Stropheodonta corrugata var. pleuristriata Foerste c.
Dalmanites limulurus Green c.
Cornulites concavus Prouty r.
Dalmanella elegantula Dalman c.
Drepanellina clarki U. & B. c.

"Gray limestone and shale, Lower Niagara (Rochester) fauna just above Keefer Sandstone horizon."

Grant County; in road along South Fork of Lunice Creek between Real Gap and Kline Gap. Elevation, 1445′ B. **Collection No. 1** from top, **No. 2** from middle, and **No. 3** from lower portion. No section measured. (Labeled 1445B, Gg. 7-3, D. B. R., p. 353c; E. R. S., pp. 552-553):

Collection No. 1:

Leperditia alta Conrad Jones aa.

Collection No. 2:

Leperditia alta Conrad Jones aa.

Collection No. 3:

Leperditia alta Conrad Jones aa.

"A dark, compact, slightly argillaceous limestone full of dark smooth ostracods of fairly large size, some $\frac{5}{8}$" in size. Is probably Niagara in age."

Grant County; on South Fork of Lunice Creek, just east of Kline Gap. Elevation, 1445′ to 1480′ B. **Collection No. 1** in lower portion of Niagara. **Collection No. 2** in extreme lower portion of Niagara or top of Clinton. No section measured. (Labeled 1445-1480B, Gg. 7-3, D. B. R., p. 354c; E. R. S., pp. 554-555, July 1, 1922):

Collection No. 1:

Whitfieldella marylandica Prouty aa.
Homeospira evax var. marylandica Prouty a.
Number of species of Kloedenella.

"Dark, fine, compact limestone. Lower Niagara horizon."

Collection No. 2:

Camarotoechia neglecta Hall c.
Stropheodonta corrugata Conrad aa.
Drepanellina clarki U. & B. a.
Homalonotus delphinocephalus Green r.
Cornulites concavus Prouty r.
Leptaena rhomboidalis Wilckens r.
Eukloedenella cf. primitoidea U. & B. r.
Cf. Whitfieldella sp.
Rhipidomella hybrida Sowerby r.
Whitfieldella marylandica Prouty r.

"Dark-gray to blue crystalline limestone, with some 'iron ore,' oolitic. Rochester fauna above Keefer Sandstone horizon."

From the stratigraphic description it would appear that Collection No. 2 is partly in the Niagara and partly in the Clinton, as classified in this Report.

MARINE INVERTEBRATE FOSSILS, CLINTON SERIES.

In the Clinton Series which is described on pages 405-413, inclusive, there are abundant marine fossils in the Fossil Ore Horizon, coming near the top of the series, and a less conspicuous fauna in the Iron Sandstone which is near the basal portion of the series. The shale members usually contain few fossils, although they are not totally barren.

Only one small and quite incomplete collection was made by the writer in the Fossil Ore Horizon, Dr. Tilton's report on it being as follows:

"A few fragments of the **Fossil Ore Horizon** (top of Clinton) were obtained from North Fork of Patterson Creek, 1¾ miles southeast of Greenland, Grant County, West Virginia. (See No. 4 in description of Katherine McDonald Prospect, page 696. These consist almost entirely of minute shells of ostracods replaced by hematite, accompanied by calcareous fragments of a few kinds of brachiopods.

"The most common ostracod is disc-like in shape, about half a millimeter in diameter and about a tenth of that in thickness, with a raised u-like spot or line in the center. These are characteristics of **Bollia lata** Vanuxem, even without expanded ends of the inner line. Other forms of about the same size have a straight hinge line, but replacement by hematite is so coarse that it is impossible to tell whether the valves overlap or not. With no evidence of overlapping such forms are considered **Isoclina-like.** Others have sulci reaching a third-way across a disc that is straight along one side (hinge). These are **Kloedenia-like.** A few forms are as long as 1.1 millimeters, with straight hinge line and with smooth surface. These few correspond to **Leperditia.**

"The brachiopods and a few other forms present are easily damaged when the rock is broken open. The shapes and markings found correspond to the following forms:

"**Camarotoechia neglecta** Hall. This is, perhaps, the most common of the brachiopods.

"**Leptaena rhomboidalis** Wilckens. One fragment only contains two impressions of the shell, large in size for the species but conforming in outline, undulations, and striations to the species named.

"**Dalmanella (Orthis) elegantula** Dalman. Four fragments of shells are referred to this species.

"**Stropheodonta corrugata** Conrad. There are six surfaces of portions of these rather large shells present.

"**Whitfieldella intermedia** Hall. Four specimens apparently of a Whitfieldella are found that correspond in shape with that of the species named. Three of these are casts of interiors with large mesial sinus with six or eight corrugations.

"**Whitfieldella cylindrica** Hall. This species is not reported present in Maryland, Pennsylvania, and New Jersey, but it is reported present in the Clinton of New York (under the synonym Atrypa). The faint striations that are present and the general shape refer four of the specimens to this species rather than to W. intermedia Hall.

"**A pelecypod.** A straight hinge line, oblique outline, with faint striations from one side of the hinge line, seem to mark a pelecypod shell, not corresponding to anything described in the Clinton. The margin is not complete.

"Gastropoda. Parts of the outer whorls of two gastropods are present, each three millimeters in diameter, smooth, circular, with low spire. No form of a like gastropod is described from the Clinton.

"Tentaculites (?) A single form is found consisting of a series of minute calcareous cones fitting into each other. In general outline it appears to be a tantaculite. There is no accompanying evidence that would indicate that it is the wall of a siphuncle of Orthoceras.

"Grabau and Shimer give the range of these species as follows:

Range of Recognized Clinton Species.

Species.	Oneida and Richmond.	Medina.	Clinton.	Niagara.	Salina.	Cobleskill.	Rondout.	Manlius.
Camarotoechia neglecta Hall			*	*				
Leptaena rhomboidalis Wilckens	*							
Dalmanella (Orthis) elegantula Dalman			*	*				
Stropheodonta corrugata Conrad			*					
Whitfieldella intermedia Hall			*	*				
Whitfieldella cylindrica Hall			*	*				
Bollia lata Vanuxem			*					
Isoclina, Kloedenia, Leperditia	*							

"In the above table Stropheodonta corrugata Conrad and Bollia lata Vanuxem mark the Clinton Formation, emphasized by the character of the beds of hematite."

In the Clinton Series, also, Prof. Scheffel and Paul H. Price made collections from 6 localities, there being 3 collections in the Fossil Ore Horizon and 4 in the Iron Sandstone. The shales do not appear to have been prospected in detail. Dr. Prouty's report on these collections is as follows:

Mineral County; on Limestone Run at axis of Wills Mountain Anticline, 1.1 miles southeast of Keyser. Collection from Iron Sandstone in basal Clinton. See description of Alkire Heirs Prospect, page 699. Labeled 900S, K. 1-53, E. R. S., p. 588):

Camarotoechia neglecta Hall c.
Buthotrephis gracilis var. intermedia Hall
Crinoid stem
Zygobolba carinifera U. & B. c.
Chilobolbina cf. punctuata U. & B. c.
Clay galls a.

"Oolitic, sandy iron ore; Lower Clinton Iron Sandstone. Rose Hill age."

Mineral County; in road which passes northwestward down Knobly Mountain, 1.2 miles southeast of New Creek town. Collection from Fossil Ore Horizon near top of Clinton. No section measured. (Labeled 1360S, Eg. 6-45, E. R. S., p. 569):

Camarotoechia neglecta Hall c.
Atrypa reticularis Linnaeus r.
Schuchertella subplana Conrad c.
Meristina cf. maria Hall
Cf. Stropheodonta corrugata Conrad c.
Stropheodonta convexa Prouty r.
Diaphorostoma niagarensis Hall r.
Leptaena rhomboidalis Wilckens r.
Spirifer crispus Hisinger r.
Liocalymene clintoni Vanuxem r.
Kloedenia cacaponensis U. & B. r.

"Oolitic iron ore and yellow porous sandstone, formerly calcareous. Clinton (Rochester) fauna, above Keefer Sandstone horizon, in oolitic iron ore."

Mineral County; in road which passes northwestward down Knobly Mountain, 1.1 miles southeast of New Creek town. Collection from Iron Sandstone in basal Clinton. No section measured. (Labeled 1250-1310S, Eg. 6-35, E. R. S., p. 507c):

Camarotoechia neglecta Hall a.
Crinoid stem (same as in 900S, K. 1-53)
Dalmanella sp.
Zygobolba carinifera U. & B.
Orthoceras bassleri Prouty
Calymene cresapensis Prouty.

"Very siliceous iron ore. Lower Clinton Iron Sandstone. Rose Hill age."

Grant County; on south side of North Fork of Patterson Creek east of Greenland Gap and 0.9 mile northwest of Falls. Collection from upper portion of Clinton, mainly from Fossil Ore Horizon. See Nos. 13-18, inclusive, of Falls Section, page 174. (Labeled 1385S, Gg. 2-43, E. R. S., p. 534):

Atrypa reticularis Linnaeus c.
Camarotoechia neglecta Hall a.
Crinoid stem aa.
Orthoceras impressus
Stropheodonta sp.
Favosites sp.

"Ferruginous sandstone. Lower part of Keefer Sandstone horizon just below more abundant Niagara (Rochester) fauna."

Grant County; on Lunice Creek 1 mile northwest of Maysville and just east of Cosner Gap. Elevation, 1430'-1445' B. **Collections Nos. 1, 2, and 3** in descending order from thin-bedded limestones of lower portion of Niagara. **Collection No. 4** from upper portion of Clinton, including Fossil Ore Horizon. **Collection No. 5** from Iron Sandstone in basal Clinton. No section measured. (Labeled 1430-1445B, Gg. 4-35 and 34, D. B. R., p. 357c; E. R. S., pp. 526-529). (For Collections Nos. 1, 2, and 3 see Niagara):

Collection No. 4:
Stropheodonta corrugata var. pleuristriata Foerste c.
Tentaculites cf. niagarensis Hall.
"Upper oolitic iron ore, Clinton fauna."

Collection No. 5:

Camarotoechia neglecta Hall c.
Crinoid stem sp. r.

"Ferruginous sandstone. Lower Clinton Iron Sandstone horizon. Rose Hill time."

Grant County; on South Fork of Lunice Creek, just east of Kline Gap. Elevation, 1445-1480′ B. **Collection No. 3** from middle and upper portion of Iron Sandstone in basal Clinton. See No. 9 of section on page 411. (Labeled 1445-1480B, Gg. 7-3, D. B. R., p. 354c; E. R. S., pp. 523-525, June 23, 1922). (For Collections Nos. 1 and 2 at this locality see Niagara):

Collection No. 3:

Camarotoechia neglecta Hall c.
Crinoid sp.
Modiolopsis sp. r.

"Iron Sandstone horizon of lower Clinton. Rose Hill time."

ORDOVICIAN FOSSILS.

At the close of the Ordovician, only a few feet of which are visible in the North Fork Gap of Grant County, fossil life was profuse, in sharp contrast to the nearly or entirely barren condition of the Medina stages which followed. It has been already explained that this almost total cessation of marine life would be considered sufficiently good reason to draw the Silurian-Ordovician boundary at the top of the Martinsburg Shale, even if there were not other important reasons for so doing.

MARINE INVERTEBRATE FOSSILS, MARTINSBURG SHALE.

In the Martinsburg Shale, which is a sort of hodge-podge assemblage of certain eastern groups that have not yet been fully differentiated in West Virginia, there is known to be a rich fauna from top to bottom, as some recent studies by Dr. Prouty and the writer in Mercer and Monroe Counties will shortly exhibit.

In Mineral and Grant Counties, as described on pages 425-9, inclusive, only a few feet of the upper portion of the Martinsburg are exposed. This abbreviated outcrop has been sufficient, however, for Drs. Tilton and Prouty to assign these beds definitely to the Maysville Formation of the Ohio nomenclature, there being two easily recognizable zones in North Fork Gap where collections were made. At the time of the writer's first visit to the locality a small collection was made, extending across both the Lingula Zone at the top and the Orthorynchula Zone coming just below. On this mixed collection Dr. Tilton makes the following report:

"The pieces of rock were obtained on the south side of North Fork of South Branch of Potomac River, two and a half miles southwest of Corners, Grant County, West Virginia. Where the rock is weathered and easily broken it is very fossiliferous, yielding especially **Orthorhynchula linneyi** James of large size. The specimens evidently came from the 'Orthorhynchula Zone.' The following specimens are found:

"**Lingula nicklesi** Bassler. Three good specimens have the subrectangular shape characteristic of this species. There are fragments of three other forms that are evidently of the same kind.

"**Orthorhynchula linneyi** James. These are large and conspicuous on weathered surfaces, and are guide fossils for this horizon.

"**Callopora (sp.)**. Two small clusters of bryozoans appear in the limestone, one in a small cavity where the original material has been dissolved away. In neither specimen are the apertures visible, but the arrangement of zoecia gives six zoecia in a space of two millimeters, and in the more perfect specimen diaphragms are numerous in the mature zone. The clusters correspond to Hall's description of Callopora, a genus that ranges from the Trenton through the Oriskany. The Maryland report mentions Callopora onealli sigillaroides (Nicholson) as found in Eden beds, but does not mention it as found in Maysville beds.

"**Modiolodon truncatus** Hall ? A single crushed specimen conforms most nearly with this species.

"**Modiolopsis modiolaris** Conrad. An incomplete specimen corresponds in outline to this species, which is looked upon as a guide fossil to the Pulaski Shale in western New York and in Ohio.

"**Byssonychia** or **Allonychia**. There are six fragments that show surface markings of either Byssonychia or of Allonychia, but all the fragments lack both hinge line and general outline, so that further identification is impossible.

"**Ischyrodonta unionoides** Meek. Three imperfect forms agree in outline and in lines of growth with this species.

"**Pelecypods.** There are seven specimens representing two genera that differ from described forms, chiefly in that they are lower posteriorly than anteriorly. They are not sufficiently complete for description. There are also six fragments of shells, apparently Pelecypods, too imperfect for identification.

"**Gastropods.** Enough of the outline is present in three specimens to indicate the presence of gastropods, but not enough for a judgment as to whether the forms are like those described in the Eden beds. These gastropods are not described in reports on the Maysville fossils.

"The Maryland report lists the range of the species recognized as follows:

Species.	Martinsburg Shale in general.
Lingula nicklesi Bassler	*
Orthorhynchula linneyi James	*
Ischyrodonta unionoides Meek	*
Modiolodon truncatus Hall ?	*
Modiolopsis modiolaris Conrad	*

"The horizon is clearly that known as the 'Orthorhynchula linneyi James Zone' of the Maysville, in the upper part of the Martinsburg Shale."

In closing his identifications and discussions of fossils collected by the writer and identified by himself in Mineral and Grant Counties, Dr. Tilton gives the following summary:

"The specimens, numbered, catalogued, and labeled, are distributed as follows:

	Catalog entries (species).	Specimens.
Ames	17	45
Pine Creek	2	9
Brush Creek	11	26
Quakertown	1	3
Chemung	27	54
Genesee	8	18
Hamilton	51	177
Marcellus	17	50
Oriskany	2	2
Helderberg	9	36
Bloomsburg	2	3
Niagara	9	46
Clinton	13	37
Martinsburg	9	45
Total	178	551

In the Martinsburg Shale, also, Prof. Scheffel and Paul H. Price made a small collection at the locality mentioned above, the same being confined entirely to the Lingula Zone. At a later date a much more exhaustive examination of the exposed beds was made by these two collectors in company with the writer and separate collections were made in the Lingula and Orthorynchula Zones. The two collections made in the Lingula Zone are given in the first list below and that from the Orthorynchula Zone is contained in the second, the identifications being by Dr. Prouty:

Grant County; on the south side of North Fork of South Branch of Potomac River in North Fork Gap 7 miles west of Petersburg, first strata exposed in bluff east of axis of Wills Mountain Anticline. Elevation, 1090′ B. See Nos. 13 and 14 of Hopeville Section. First collection made by Scheffel and Price included only a few Lingulae, etc., near Gray Medina contact (Labeled 1090B, P. 1-1, D. B. R., p. 346c; E. R. S., pp. 505-506); second collection made by Reger, Scheffel, and Price included both Nos. 13 and 14 of Hopeville Section, page 177, (Labeled 1090B, P. 1-1, D. B. R., p. 346c; E. R. S., p. 584):

Lingula nicklesi Bassler
Protowarthia sp.
Ctenodonta cf. obliqua
Orthoceras lamellosum Hall
Ctenodonta cf. gibberula Salter
Cyrtolites close to inornatus Hall
Sedgwichia close to compressus Meek
Nuculites sp.
Modiolopsis sp.
"Lingula Zone, Maysville in age."

Orthorhynchula linneyi James aa.
Modiolodon truncatus Hall a.
Byssonychia praecursa Ulrich c.
Lingula sp. fragments
Lingula nicklesi Bassler
Tetranota sp. near T. obsoleta
Ctenodonta obliqua
Nuculites sp. near N. neglecta.
"Orthorhynchula Zone. Maysville in age."

APPENDIX.

Levels Above Mean Tide.

RAILROAD LEVELS.

BALTIMORE AND OHIO RAILROAD.

(Elevations based on top of rail.)

Main Line.

Mi. from Brunswick.	Stations.	State.	County.	Elevation. Feet.
78.2	Paw Paw	West Virginia	Morgan	529.83
80.8	Little Cacapon	West Virginia	Hampshire	533.09
83.0	Okonoko	West Virginia	Hampshire	539.01
85.8	French	West Virginia	Hampshire	541.48
88.4	Green Spring	West Virginia	Hampshire	555.97
94.9	Patterson Creek	West Virginia	Mineral	574.16
100.1	Evitts Creek	Maryland	Allegany	637.44
102.5	Cumberland	Maryland	Allegany	632.09
103.0	Viaduct Junction	Maryland	Allegany	649.2
104.4	Green Street	Maryland	Allegany	642.98
106.1	Roberts	Maryland	Allegany	639.57
107.7	Cedar Cliff	Maryland	Allegany	651.21
109.2	Brady	Maryland	Allegany	657.87
111.5	McKenzie	Maryland	Allegany	699.46
112.2	Potomac	Maryland	Allegany	691.62
113.3	Renix	Maryland	Allegany	678.99
113.9	Lowndes	Maryland	Allegany	688.08
114.4	Bier	Maryland	Allegany	696.53
114.9	Cresap	Maryland	Allegany	700.99
115.5	Rawlings	Maryland	Allegany	707.33
119.0	Black Oak	Maryland	Allegany	744.53
121.1	Dawson	Maryland	Allegany	753.31
123.5	Twenty-first Bridge	Maryland	Allegany	796.43
125.5	Keyser	West Virginia	Mineral	814.75
130.5	Piedmont	West Virginia	Mineral	919.32
131.7	W. Va. Central Junc.	West Virginia	Mineral	969.10
132.6	Bloomington	Maryland	Garrett	1040.54
138.3	Frankville	Maryland	Garrett	1705.82
143.5	Swanton	Maryland	Garrett	2291.93
147.4	Altamont	Maryland	Garrett	2572.58

Petersburg (South) Branch.

Mi. from Green Spring.	Stations.	State.	County.	Elevation. Feet
0.0	Green Spring	West Virginia	Hampshire	557.9
1.3	Millen	West Virginia	Hampshire	575.3
3.3	Donaldson	West Virginia	Hampshire	623.3
7.3	Milleson	West Virginia	Hampshire	777.9
7.5	Springfield	West Virginia	Hampshire	780.6
9.3	Grace	West Virginia	Hampshire	653.1
10.0	Ritters	West Virginia	Hampshire	635.0
10.9	Ridgedale	West Virginia	Hampshire	655.5
12.5	Rocks	West Virginia	Hampshire	647.4
13.3	Vance	West Virginia	Hampshire	655.2
15.2	Wapocomo	West Virginia	Hampshire	667.3
15.4	Romney Junction	West Virginia	Hampshire	668.6
16.4	Romney	West Virginia	Hampshire	731.0
17.6	West Romney	West Virginia	Hampshire	682.5
20.7	Hampshire Club	West Virginia	Hampshire	717.4
22.4	Johnson	West Virginia	Hampshire	728.2
23.7	Pancake	West Virginia	Hampshire	725.4
26.2	Glebe	West Virginia	Hampshire	725.2
27.5	Wickham	West Virginia	Hampshire	742.3
32.2	Sycamore	West Virginia	Hardy	771.7
33.3	McNeill	West Virginia	Hardy	776.6
35.2	Mapleton	West Virginia	Hardy	771.5
36.6	Cunningham	West Virginia	Hardy	787.1
37.4	Meadow	West Virginia	Hardy	803.4
39.1	Moorefield	West Virginia	Hardy	820.5
41.3	Taylor	West Virginia	Hardy	823.6
43.5	Brook Hill	West Virginia	Hardy	852.0
45.1	Spring Brook	West Virginia	Hardy	859.4
46.8	Durgon	West Virginia	Hardy	877.9
48.7	Welton	West Virginia	Hardy	901.5
51.9	Petersburg	West Virginia	Grant	933.5
52.0	End of Line	West Virginia	Grant	936.0

The elevations and distances given above are as recently given the Survey by the Chief Engineer of the Baltimore and Ohio Railroad through the courtesy of Dr. G. P. Grimsley, of the Commercial Development Department of that road, the same having been recently resurveyed for valuation purposes for the United States Government.

Patterson Creek & Potomac Railroad of West Virginia Branch.

Mi. from Patterson Cr.	Stations.	State.	County.	Elevation. Feet.
0.0	Patterson Creek	West Virginia	Mineral	574.2
4.6	Knobley Tunnel	West Virginia	Mineral	723.6
6.2	McKenzie	Maryland	Allegany	677.8

THE WESTERN MARYLAND RAILWAY.

(Elevations based on sub-grade; for top of rail about 1½ feet should be added.)

Main Line.

Mi. from Baltimore.	Stations.	State.	County.	Elevation. Feet.
120.4	Roundtop	Maryland	Washington	482
127.4	Pearre	Maryland	Washington	458
131.1	Little Orleans	Maryland	Allegany	494
132.6	Doe Gully	West Virginia	Morgan	500
137.1	Baird	West Virginia	Morgan	525
143.8	Fairplay	Maryland	Allegany	552
147.1	Town Creek	Maryland	Allegany	549
151.2	Oldtown	Maryland	Allegany	569
155.9	Sloan	Maryland	Allegany	587
163.5	South Cumberland	Maryland	Allegany	624
164.7	Knobmount	West Virginia	Mineral	631
168.0	Seymour	West Virginia	Mineral	649
171.2	Potomac	West Virginia	Mineral	681
172.3	Frost	Maryland	Allegany	680
173.3	Bier	Maryland	Allegany	697
174.5	Rawlings	Maryland	Allegany	710
178.0	Black Oak	Maryland	Allegany	740
179.3	Gerstell	West Virginia	Mineral	749
180.0	Dawson	Maryland	Allegany	761
182.0	Twenty-first	Maryland	Allegany	800
184.1	Keyser Junction	Maryland	Allegany	815
184.4	Keyser	West Virginia	Mineral	803
189.4	Westernport	Maryland	Allegany	921
190.8	W. Va. Central Junc.	West Virginia	Mineral	961
195.2	Warnocks	West Virginia	Mineral	1094
195.7	Windom	West Virginia	Mineral	1145
197.4	Barnum	West Virginia	Mineral	1186
200.1	Shaw	West Virginia	Mineral	1301
203.9	Chaffee	West Virginia	Mineral	1480
207.3	Blaine	West Virginia	Mineral	1618
209.1	Harrison	West Virginia	Mineral	1694
214.1	Schell	West Virginia	Mineral	2010
217.7	Wallman	Maryland	Garrett	2227
219.7	Steyer	Maryland	Garrett	2314
221.7	Gorman	Maryland	Garrett	2330
224.1	Bayard	West Virginia	Grant	2356
226.6	Wilson	West Virginia	Grant	2514
228.1	Dobbin	West Virginia	Grant	2606
229.3	Henry	West Virginia	Grant	2656
231.3	Wilsonia	West Virginia	Grant	2736
233.1	Beechwood	West Virginia	Grant	2866
235.9	Fairfax	West Virginia	Grant	3050
.....	Fairfax Summit	West Virginia	Grant	3070
237.5	William	West Virginia	Tucker	2996
239.6	Thomas	West Virginia	Tucker	2956
240.5	Coketon	West Virginia	Tucker	2872
241.4	Douglas	West Virginia	Tucker	2806
249.6	Hendricks	West Virginia	Tucker	1712
250.5	Hambleton	West Virginia	Tucker	1694
252.9	Parsons	West Virginia	Tucker	1656

Elk Garden Branch.

Mi. from Baltimore.	Stations.	State.	County.	Elevation. Feet.
209.1	Harrison	West Virginia	Mineral	1694
210.3	Oakmont	West Virginia	Mineral	1807
212.0	Hartmansville Junc.	West Virginia	Mineral	1944
212.4	Emoryville	West Virginia	Mineral	1985
216.1	Elk Garden	West Virginia	Mineral	2298

Hartmansville Branch.

Mi. from Baltimore.	Stations.	State.	County.	Elevation. Feet.
212.0	Hartmansville Junc.	West Virginia	Mineral	1944
214.5	End of branch	West Virginia	Mineral	2198

Knobmount to Cumberland Branch.

Mi. from Baltimore.	Stations.	State.	County.	Elevation. Feet.
164.7	Knobmount	West Virginia	Mineral	631
166.3	Ridgeley	West Virginia	Mineral	625
167.0	Cumberland	West Virginia	Mineral	626

UNITED STATES GOVERNMENT LEVELS.

The various topographic quadrangles which make up the areas of Mineral and Grant Counties have been covered with a network of primary spirit-levels run by the United States Geological Survey. In addition to these a precise line has been run by the United States Coast and Geodetic Survey and the Baltimore and Ohio Railroad along the main line of the latter which passes through parts of Mineral County.

The following descriptive remarks are quoted from Bulletin No. 632 of the United States Geological Survey, pages 5-7; 1916:

"**Classification.**—The elevations are classified as precise or primary, according to the methods employed in their determination. The former are determined by lines of levels run either in both

forward and backward directions or by simultaneous double-rodded lines, a high-grade instrument being used and special precautions being taken in observations and reduction to correct errors and make the line continuously good throughout. The latter or primary levels are determined with the Y level, precautions being taken against only the principal errors and the levels being run mostly in circuits of single lines. The allowable limit of error observed on the precise work already done by the Geological Survey in this State is represented in feet by 0.02 times the square root of D and that for the primary work by 0.05 times the square root of D, in which D is the length of circuit in miles.

"**Bench marks.**—The standard bench marks are of two forms. The first form is a circular bronze or aluminum tablet (**C** and **E**, Pl. I), 3½ inches in diameter and ¼ inch thick, having a 3-inch stem, which is cemented in a drill hole in solid rock in the wall of some public building, a bridge abutment, or other substantial masonry structure. The second form (**F**, Pl. I), used where masonry or rock is not available, consists of a hollow wrought-iron post 3½ inches in outer diameter and 4 feet in length. The bottom is spread out to a width of 10 inches in order to give a firm bearing on the earth. A bronze or aluminum cap is riveted upon the top of the post which is set about 3 feet in the ground. A third style of bench mark, with abbreviated lettering (**B** and **D**, Pl. I), is used for unimportant points. This consists of a special copper nail 1½ inches in length driven through a copper washer ⅝ inch in diameter. The tablets as well as the caps on the iron posts are appropriately lettered, and cooperation by States is indicated by the addition of the State name (**G**, Pl. I).

"The numbers stamped on the bench marks described in the following pages represent the elevations to the nearest foot as determined by the levelman. These numbers are stamped with 3/16-inch steel dies on the tablets or post caps, to the left of the word 'Feet.' The office adjustment of the notes and the reduction of mean sea-level datum may so change some of the figures that the original markings are 1 to 2 feet in error. It is assumed that engineers and others who have occasion to use the bench-mark elevations will apply to the Director of the United States Geological Survey, at Washington, D. C., for the adjusted values, and will use the markings as identification numbers only.

"**Datum.**—All elevations determined by the United States Geological Survey and United States Coast and Geodetic Survey are referred to mean sea-level, which is the level that the sea would assume if the influence of winds and tides were eliminated. This level is not the elevation determined from the mean of the highest and the lowest tides, nor is it the half sum of the mean of all the high tides and the mean of all the low tides, which is called the half-tide level. Mean sea-level is the average height of the water, all stages of the tide being considered. It is determined from observations made by means of tidal gages placed at stations where local conditions, such as long narrow bays, rivers, and like features, will not affect the height of the water. To obtain even approximately correct results these observations must extend over at least one lunar month, and if accuracy is desired they must extend over several years. At ocean stations the half-tide level and the mean sea-level usually differ but little. It is assumed that there is no difference between the mean sea-levels determined from observations in the Atlantic Ocean, the Gulf of Mexico, and the Pacific Ocean.

"The connection with tidal stations for bench marks in certain areas that lie at some distance from the seacoast is still uncertain, and this fact is indicated by the addition of a letter or word to the

right of the word 'Datum' on tablets and posts. For such areas corrections for published results will be made from time to time as the precise-level lines of the United States Geological Survey, the United States Coast and Geodetic Survey, or other Government organizations are extended."

PRECISE LEVELS BY UNITED STATES COAST AND GEODETIC SURVEY AND BALTIMORE AND OHIO RAILROAD.

The precise levels of the United States Coast and Geodetic Survey and the Baltimore and Ohio Railroad from Green Spring, Hampshire County, westward to West Virginia Central Junction, Mineral County, are herein assembled from Bulletins Nos. 563 and 632 of the United States Geological Survey. The benches are partly in Maryland and partly in West Virginia but afford valuable points of reference for all the northern edge of Mineral County. The levels are as follows:

FLINTSTONE QUADRANGLE.

(Latitude 39° 30′-39° 45′; longitude 78° 30′-78° 45′).

From Green Spring west along Baltimore & Ohio R. R. to Patterson Creek.

From Bulletin No. 632, page 144; 1916.

	Feet.
Green Spring, near, at mile-post "Baltimore 164 miles," on south side of tracks in center of coping of culvert 62; copper bolt (B. & O. bench mark 139)	551.935
(1903 adjusted value = 552.351).	
Green Spring, about 1 mile west of, opposite mile-post "Baltimore 165 miles;" section of rail set vertically in ground (B. & O. bench mark 140)	559.238
(1903 adjusted value = 559.656).	
Green Spring, about 2 miles west of, opposite mile-post "Baltimore 166 miles"; section of rail set vertically in ground (B. & O. bench mark 141)	562.076
(1903 adjusted value = 562.497).	
Green Spring, about 3 miles west of, opposite mile-post "Baltimore 167 miles"; section of rail set vertically in ground (B. & O. bench mark 142)	559.677
(1903 adjusted value = 560.101).	
Dans Run, opposite mile-post "Baltimore 168 miles"; section of rail set vertically in ground (B. & O. bench mark 143)	564.851
(1903 adjusted value = 565.281).	
Dans Run, about 1 mile west of, opposite mile-post "Baltimore 169 miles"; section of rail set vertically in ground (B. & O. bench mark 144)	565.878
(1903 adjusted value = 566.310).	
Patterson Creek Cut-Off, about 0.5 mile east of bridge, opposite mile-post "Baltimore 170 miles"; section of rail set vertically in ground (B. & O. bench mark 145)	567.574
(1903 adjusted value = 568.009).	

Feet.

Patterson Creek Cut-Off, south end of west abutment of railroad bridge over Patterson Creek (U. S. G. S. bench mark, 574 Patterson Creek)..... 573.805
(1903 adjusted value = 574.242).

Patterson Creek Cut-Off, between tracks, in a bridge seat of the east abutment of bridge 63; copper bolt (B. & O. bench mark 145A)..... 568.936
(1903 adjusted value = 569.372).

Patterson Creek, about 0.3 mile northwest of, opposite mile-post "Baltimore 171 miles"; section of rail set vertically in ground (B. & O. bench mark 146)..... 575.163
(1903 adjusted value = 575.601).

FLINTSTONE QUADRANGLE.

(Latitude 39° 30′-39° 45′; longitude 78° 30′-78° 45′).

From point near North Branch along Baltimore & Ohio R. R. to point near Evitts Creek.

From Bulletin No. 563, page 56; 1914.

North Branch, 0.5 mile southeast of, opposite mile-post 172, between tracks; top of vertical rail section (B. & O. R. R. b. m. 147)..... 598.307

North Branch, bridge over North Branch of Potomac River, in bridge seat of west abutment, between tracks; copper bolt (B. & O. R. R. b. m. 147A)..... 602.514

North Branch, 0.5 mile northwest of, opposite mile-post 173, between tracks; top of vertical rail section (B. & O. R. R. b. m. 148)..... 625.176

North Branch, 1.5 miles northwest of, opposite mile-post 174, between tracks; top of vertical rail section (B. & O. R. R. b. m. 149)..... 637.056

Evitts Creek, 1 mile southeast of, opposite mile-post 175, between tracks; top of vertical rail section (B. & O. R. R. b. m. 150)..... 629.429

FROSTBURG QUADRANGLE.

(Latitude 39° 30′-39° 45′; longitude 78° 45′-79°).

From Cumberland southwest 12 miles.

From Bulletin No. 563, page 56; 1914.

Cumberland, at western terminus of Chesapeake & Ohio Canal on coping stone of feed lock; cut marked "I B. □ M. U. S. C. S. 1878" (C. & G. S. b. m. I)..... 623.766

Cumberland, 5.5 miles southwest of, on abutment of small drain on Baltimore & Ohio R. R.; cut marked "B □ M" (C. & G. S. b. m. No. XVII)..... 647.393

Cumberland, 12 miles southwest of, at southwest angle of drain on Baltimore & Ohio R. R.; cut on foundation stone, marked "B □ M" (C. & G. S. b. m. No. XVIII)..... 693.992

From point near Evitts Creek along Baltimore & Ohio R. R. to point 2 miles south of Cooks Mills.

From Bulletin No. 563, pages 56-57; 1914.

	Feet.
Evitts Creek, 0.1 mile west of, opposite mile-post 176, between tracks; top of vertical rail section (B. & O. R. R. b. m. 151)	638.435
Cumberland, 1 mile east of, opposite mile-post 177, between tracks; top of vertical rail section (B. & O. R. R. b. m. 152)	648.129
Cumberland, opposite mile-post 178, between tracks; top of vertical rail section (B. & O. R. R. b. m. 153)	632.601
Cumberland, Queen City Hotel, in front of railing to right of stairway leading to relief department, in top of wall; copper bolt (B. & O. R. R. b. m. 153A)	639.762
Cumberland, Grafton Line, at east end of viaduct bridge, on south side of tracks; copper bolt (B. & O. R. R. b. m. 154)	644.338
Cumberland, 1.5 miles west of, on south side of tracks, in foundation of overhead foot-bridge; copper bolt (B. & O. R. R. b. m. 155)	653.430
Cumberland, 2.5 miles west of, Pennsylvania R. R. overhead crossing at the Narrows, in south end of east pier of north span; copper bolt (B. & O. R. R. b. m. 156)	656.199
Mount Savage Junction, east abutment of first bridge east of, between tracks; copper bolt (B. & O. R. R. b. m. 157)	681.468
Mount Savage Junction, east abutment of bridge 1 of Connellsville Division, between tracks; copper bolt (B. & O. R. R. b. m. 158)	710.440
Ellerslie, in bridge seat of east abutment of bridge 2½, between tracks; copper bolt (B. & O. R. R. b. m. 160A)	727.971

From point near Cumberland along Baltimore & Ohio R. R. to point near Dawson.

From Bulletin No. 563, pages 57-58; 1914.

Cumberland, near Green Street Station, overhead bridge 180C, in north end of extension of west abutment; copper bolt (B. & O. R. R. b. m. 1)	647.699
Roberts Station, near, 700 feet south of mile-post 181, in west end of south wall of small culvert; copper bolt (B. & O. R. R. b. m. 3)	632.911
Roberts Station, 0.1 mile south of, at telegraph-pole 182-7, on small arch culvert, in north coping; copper bolt (B. & O. R. R. b. m. 4)	637.475
Cedar Cliff, near, on culvert at telegraph-pole 183-11, in north coping; copper bolt (B. & O. R. R. b. m. 5)	648.532
Cedar Cliff, near, at telegraph-pole 184-6, stone culvert, in north end of west coping; square cut (B. & O. R. R. b. m. 6)	647.706
Brady, near, at telegraph-pole 184-22, north side of abutment to bridge 71; copper bolt (B. & O. R. R. b. m. 6A)	647.277
Brady, 0.1 mile southwest of, at telegraph-pole 185-10, in east end of north coping of culvert; copper bolt (B. & O. R. R. b. m. 7)	660.150
Brady, 1 mile southwest of, at telegraph-pole 186-2, west of tracks, in native rock; copper bolt (B. & O. R. R. b. m. 7A)	666.668

	Feet.
McKenzie Station, 0.5 mile east of, at telegraph-pole 186-37, on undergrade highway bridge crossing, in north abutment; copper bolt (B. & O. R. R. b. m. 8)	680.759
Potomac Station, on undergrade highway bridge, in north abutment; copper bolt (B. & O. R. R. b. m. 9)	688.345
Pinto, near, 500 feet northeast of mile-post 189, on arch culvert, in north coping; copper bolt (B. & O. R. R. b. m. 10)	672.482
Lowndes, near, 150 feet southwest of mile-post 190, on culvert in north coping; copper bolt (B. & O. R. R. b. m. 11)	683.240
Cresap, near, at telegraph-pole 190-23, on culvert, in north abutment; copper bolt (B. & O. R. R. b. m. 12)	698.825
Rawlings, 800 feet southwest of, on bridge 75, opposite telegraph-pole 191-23, in bridge seat of abutment toward Wheeling, copper bolt (B. & O. R. R. b. m. 13)	703.575
Rawlings, near, opposite mile-post 193, between tracks; top of vertical rail section (B. & O. R. R. b. m. 14)	718.319
Black Oak, near, opposite mile-post 194, between tracks; top of vertical rail section (B. & O. R. R. b. m. 15)	724.961
Black Oak, 200 feet southwest of, opposite mile-post 195, between tracks; top of vertical rail section (B. & O. R. R. b. m. 16)	743.804
Black Oak, 0.9 mile southwest of, at telegraph-pole 195-30, Western Maryland Ry. bridge, in northwest end of northeast abutment; copper bolt (B. & O. R. R. b. m. 17)	740.252

KEYSER QUADRANGLE.

(Latitude 39° 15′-39° 30′; longitude 78° 45′-79°).

Along Baltimore and Ohio R. R. near Keyser.

From Bulletin No. 632, page 145; 1916.

Keyser, near, opposite telegraph-pole 201-8, set between tracks in south abutment of bridge; copper bolt (B. & O. bench mark 22)	800.700
Keyser, near center of Keyser yards, opposite mile-post 202; section of rail set vertically in ground (B. & O. bench mark 23)	827.000
Keyser, at northwest end of Keyser yards, opposite mile-post 203; section of rail set vertically in ground (B. & O. bench mark 24)	837.597
Keyser, near, opposite mile-post 204; section of rail set vertically between tracks (B. & O. bench mark 25)	854.578

ELK GARDEN QUADRANGLE.

Latitude 39° 15′-39° 30′; longitude 79°-79° 15′).

Along Baltimore & Ohio R. R. near Piedmont.

From Bulletin No. 632, page 145; 1916.

Piedmont, near, in bridge seat of abutment at telegraph-pole 204-30; copper bolt (B. & O. bench mark 26)	871.281
Piedmont, near, at telegraph-pole 205-21, in abutment of bridge; copper bolt (B. & O. bench mark 26A)	889.273

	Feet.
Piedmont, 0.5 mile southeast of, opposite mile-post 206; section of rail set vertically between tracks (B. & O. bench mark 27)	906.084
Piedmont, 0.5 mile southwest of, opposite mile-post 207; section of rail set vertically in ground between tracks (B. & O. bench mark 28)	932.915
West Virginia Central Junction, 400 feet west of, in southwest end of bridge seat northwest of abutment of bridge for siding over Potomac River; copper bolt (B. & O. bench mark 28A)	948.302

PRIMARY LEVELS OF UNITED STATES GEOLOGICAL SURVEY.

The following primary levels by the United States Geological Survey are taken in part from Bulletin No. 632, as indicated, but are mainly from unpublished data supplied by the Director, their arrangement being by the topographic quadrangles of the two counties in alphabetical order:

DAVIS QUADRANGLE.

(Latitude 39°-39° 15′; longitude 79° 15′-79° 30′).

From Dobbin southwest along Western Maryland R. R. to Thomas.

Leveling by K. F. Maxcy in 1916.

Dobbin, 700 feet north of station, in west end of north abutment of railroad bridge, in capstone; bronze tablet stamped "2582"	2,582.003
Dobbin, opposite station, top of rail	2,594.4
Henry, 800 feet north of station, in top of boulder, north of track; chiseled square	2,642.96
Henry, opposite station, top of rail	2,645.23
Henry, 1.07 miles south of, in top of boulder, north of track; chiseled square	2,668.87
Wilsonia, 1.08 miles northeast of, 1700 feet northeast of mile-post "C 69" in flat slab of rock, east of track; bronze tablet stamped "2673 W. Va."	2,672.994
Wilsonia, opposite station, top of east rail	2,725.6
Wilsonia, 0.27 mile south of, opposite mile-post "C 70," in top of rock east of track; chiseled square	2,746.76
Kempton, in north end of station platform; copper nail	2,856.39
Beechwood, 800 feet south of, in top of boulder, west of track; bronze tablet stamped "2901 W. Va."	2,900.912
Fairfax, 0.6 mile north of, in ledge east of track; chiseled square	2,995.41
Fairfax, in switch-block opposite station; copper nail	3,038.71
Fairfax, 0.62 mile south of, in southeast corner of concrete base of shaft for locomotive coaling station; bronze tablet stamped "W. Va. 3052"	3,051.785
William, in north end of station platform; copper nail	2,984.88
Thomas, 1 mile north of, 25 feet southeast of mile-post "C 77," in top of boulder; chiseled square	2,971.85
Thomas, water-level, above the Davis Company's dam	2,960.2
Thomas, on east side of station, top of rail	2,948.2

Feet.

Thomas, in southwest corner of Davis Coal & Coke Company's office; aluminum tablet stamped "2986 ADJ 1903" 2,986.062

From near Childs Crossing east along Davis Branch Western Maryland R. R. to Davis. (Leveled twice.)

NOTE: Between Childs Crossing and the first bench mark of this line the two runnings differed 0.5 foot and the lesser value was assumed to be correct but a third line should have been run.

Davis, 3 miles southwest of, on Western Maryland R. R., in capstone of north abutment east wing of railroad bridge; chiseled square marked "U. S." 3,043.78
Francis, opposite north end of station, top of rail 3,084.8
Davis, 2 miles southwest of, on Western Maryland R. R., in mile-post north of track; iron spike 3,099.55
Davis, 1 mile west of, on Western Maryland R. R., in top of boulder south of track, 400 feet west of mile-post; chiseled square 3,140.56
Davis, in steps of Blackwater Hotel; bronze tablet marked "Blackwater Hotel" — "Buck — 1910" 3100. 462 (Private survey) 3,100.657

From Davis along highways southeast of Cortland, thence south and west to Red Creek Post-Office.

Davis, east end of Williams Street in highway bridge over Beaver Creek, west abutment, south wing; bronze tablet stamped "3079" 3,079.073
Blackwater River, bridge over; water elevation 3,081
Davis, 0.75 mile east of, on highway to Canaan Valley, 150 feet south of small wooden bridge, in top of boulder, west of road; chiseled square 3,157.22
Davis, 2 miles southeast of, on highway to Canaan Valley, 400 feet south of small wooden culvert, west of road; on top of boulder; chiseled square 3,537.01
Davis, 3 miles southeast of, on highway to Canaan Valley, near summit of mountain, 0.1 mile east of small wooden bridge in face of flat outcrop of rock, south of road; bronze tablet stamped "3676" 3,675.831
Cortland, 2 miles north of, on highway to Davis, in top of rock projecting from bank, west of road; chiseled square 3,579.72
Cortland, 1 mile north of, on highway to Davis, near Maple Grove School, in flooring of sheep-scales east of road; copper nail 3,222.33
Cortland, 35 feet east of south end of highway bridge over North Branch of Blackwater River, in top of fragment of ledge; bronze tablet stamped "3163" 3,162.481
Cortland, 1 mile south of, in root of pine tree, 60 feet northeast of Cortland Church; copper nail 3,214.98
Cortland, 2 miles south of, in gate-post at the Thompson place, east of road; iron spike 3,244.33
Blackwater River, bridge over 3,216.54
Blackwater River, water-level 3,209
Buena P. O., 1 mile north of, 450 feet north of road fork at Cosner School, in top of outcrop of limestone ledge, 10 feet west of right of way in field; bronze tablet stamped "3263" 3,262.619

	Feet.
Cosner School, telephone-pole at road fork	3,303.1
Buena P. O., telephone-pole at road fork, 0.5 mile north of	3,298.8
Buena P. O., 125 feet north of, west of highway, in top of limestone ledge; chiseled square	3,266.08
Buena P. O., 1 mile south of, at fork of road near Harr Schoolhouse, in top of rock at south end of small culvert; chiseled square	3,261.21
Red Creek P. O., 0.5 mile east of, in top of boulder, south of road; chiseled square	2,801.33
Red Creek P. O. (Flanagan Hill), at fork of Dry Fork road with Canaan Valley road, at northeast corner of Hedrick's blacksmith shop, in top of slab of rock; bronze tablet stamped "2556"	2,555.434

From Dobbin along Dobbin Lumber R. R. south and west to Camp No. 9, thence west along highway to Cortland.

NOTE: After applying rod and orthometric corrections an error of 0.54 foot was adjusted in this line in 33 miles.

Dobbin, 1 mile east of, east of railroad, in top of boulder; chiseled square	2,712.15
Dobbin, 1.75 miles east of, north of track, in top of boulder; chiseled square	2,866.11
Red Oak Creek, bridge over	3,069.1
Red Oak Creek, water-level	3,057
Red Oak Water-Tank, rail, opposite	3,112.9
Dobbin, 3 miles east of, 550 feet east of Red Oak Water-Tank, in large sandstone rock north of track; bronze tablet stamped "3131"	3,130.962
Red Oak Water-Tank, 0.9 mile east of, at crossing of gas pipeline, in top of rock south of track; chiseled square	3,252.40
Old Gatzmer Coal Mine, 1.4 miles west of, in switch-block, west of track; copper nail	3,296.57
Old Gatzmer Coal Mine, in sandstone ledge, north of track, bronze tablet stamped "3251"	3,251.580
Bridge, over Beaver Creek	3,266.4
Beaver Creek, water-level	3,205
Old Gatzmer Coal Mine, 0.8 mile east of, 200 feet east of trestle over Beaver Creek, in top of boulder, west of track; chiseled square	3,229.63
Canaan Water-Tank, 2.14 miles west of, in top of boulder, north of track; chiseled square	3,425.60
Canaan Water-Tank, trestle, 1.28 miles north of	3,499.5
Canaan Water-Tank, 0.67 mile north of, in sandstone ledge jutting out from bank east of track; bronze tablet stamped "3535"	3,535.368
Canaan Water-Tank, 870 feet south of, in top of boulder, east of track; chiseled square	3,590.59
Canaan Water-Tank, elevation of west rail, opposite	3,582.4
Camp No. 5, 300 feet west of, in top of boulder, west of track; chiseled square	3,642.69
Stony River Dam Junction, 1000 feet west of, at summit of mountain, 200 feet west of Babcock Lumber Company's fence, in sandstone boulder east of track; bronze tablet stamped "3686"	3,686.900
Stony River Dam Junction, top of north rail at	3,692.26

	Feet.
Stony River Dam Junction, 1 mile east of, at switch, in jutting rock east of track; chiseled square	3,708.10
Stony River Dam Junction, 1.6 miles southeast of, west of track in top of boulder; chiseled square	3,733.58
Camp No. 6, 1 mile north of, in top of sandstone boulder west of track (1.1 miles north of highest point on railroad); bronze tablet stamped "3796"	3,796.148
Camp No. 6, rail opposite	3,959.39
Camp No. 6, 1100 feet south of, at highest point in railroad, in switch-block of Y; copper nail	3,984.64
Camp No. 6, 1.1 miles south of, in sandstone boulder northeast of track; chiseled square	3,961.88
Camp No. 7, junction of track to	3,898.93
Camp No. 8, 1.3 miles north of, east of track, in small sandstone boulder on edge of right of way; bronze tablet stamped "3852"	3,852.268
Red Creek, bridge over headwaters of	3,775.0
Red Creek, surface of water, June 13, 1916	3,770.3
Pulp Job Camp, bridge 330 feet south of	3,752.7
Camp No. 8, 1000 feet north of, in switch-block of Y; copper nail	3,733.56
Camp No. 8, track at north end of	3,717.9
Red Creek, bridge over, 0.53 mile south of Camp No. 8	3,703.2
Camp No. 8, 1.25 miles southwest of, 150 feet east of small wooden bridge, in top of boulder, north of track; chiseled square	3,777.24
Camp No. 8 and Camp No. 9, crest of hill between	3,880.7
Camp No. 9, 250 feet west of, on south side of Y, in large boulder, north of track; bronze tablet stamped "3801"	3,800.836
Cortland, 3.5 miles east of, at highest point in trail from farm of Jason Harman to Dobbin Lumber Camp No. 9, in top of flat slab of rock; chiseled square	4,048.53
Cortland, 2 miles east of, 150 feet southeast of farm house of Jason Harman, on top of sandstone boulder in barn yard; north side of road, chiseled square painted "3,266.4"	3,266.24
Cortland, 0.9 mile east of, 200 feet northwest of wooden highway bridge over Blackwater River, east of highway, in top of boulder; chiseled square	3,188.25

From Davis northeast along highways to Old Gatzmer Coal Mine.

Leveling by E. E. Harris in 1916.

Davis, 1.0 mile northeast of, 30 feet southeast of rocks in small stream bed, south of wooden culvert; on sandstone rock; chiseled square painted "3084.6"	3,084.66
Davis, 2.4 miles northeast of, 30 feet west of tracks, on stone; chiseled square painted "3085.2"	3,085.26
Davis, 3.3 miles northeast of, 160 feet south of wooden trestle over Beaver Creek, south side of track, in sandstone boulder; bronze tablet stamped "3094 1916", boulder painted "3093.9"	3,094.076
Davis, 4.3 miles northeast of, 20 feet north of tracks, on sandstone rock; chiseled square, rock painted "3105"	3,105.17
Davis, 5.5 miles northeast of, on west side of tracks, on sandstone rock; chiseled square, rock painted "3111.3"	3,111.35

From west border of quadrangle southwest along highway to south border of quadrangle near Hopeville, Onego Quadrangle.

Primary leveling by Walter McCrea in 1919.

NOTE: An error of 0.6 foot was adjusted in this line from Scherr, Greenland Gap Quadrangle, to Hopeville, Onego Quadrangle. Line should be releveled.

	Feet.
Scherr, 11.6 miles south of, 500 feet north of road leading east, 5 feet west of road, in root of large chestnut oak tree; copper nail and washer, tree marked "T. B. M. 1,766"	1,765.74
Scherr, 12.4 miles south of, 115 feet south of road leading to Noah Burg's dwelling, 10 feet east of road, in large flat rock; bronze tablet stamped "1,669 W. Va."	1,668.900
Scherr, 13.5 miles south of, 500 feet southwest of **Jordan Run Post-Office,** opposite schoolhouse, southeast of road, in root of large oak tree; copper nail and washer, tree marked "T. B. M. 1,530"	1,530.24
Scherr, 14.5 miles south of, 1 mile south of **Jordan Run Post-Office,** east side of road, in large rock; chiseled square, stone marked "T. B. M. 1,427"	1,427.10

ELK GARDEN QUADRANGLE.

(Latitude 39° 15′-39° 30′; longitude 79°-79° 15′).

From Bloomington and West Virginia Central Junction southwest along Western Maryland R. R. to near Schell.

Leveling by K. F. Maxcy in 1916.

Bloomington, 0.2 mile east of, on bridge 79 over North Branch of Potomac River second step from top, in north bridge abutment; copper bolt (B. & O. B. M. 29)	1,008.860
West Virginia Central Junction, 400 feet east of, in south end of bridge seat, southwest abutment of bridge for siding over North Branch of Potomac River; copper bolt (B. & O. B. M. 28A)	948.302
Western Maryland R. R., b. m. "955.50" not described	954.75
West Virginia Central Junction, top of south rail on Western Maryland R. R., in front of station	955.8
Franklin, 435 feet south of station, in switch-block near B. & O. overhead crossing	981.56
Hampshire, top of west rail in front of station	1,020.4
Hampshire, 0.38 mile south of, in west end of bridge seat, north abutment of railway bridge over Piney Swamp Run; bronze tablet stamped "1020" P. T. Sta. 3 W. Va. 1919	1,020.468
Hampshire, 1.2 miles south of, in boulder, north of track; chiseled square	1,026.94
Warnocks, 1 mile northwest of, in boulder, north of track; chiseled square	1,062.88
Warnocks Siding, north end of, in switch-block; copper nail	1,085.75
Warnocks, opposite station, top of rail	1,092.4
Warnocks, top of west rail of main track at crossing	1,092.08

	Feet.
Warnocks, 800 feet south of southern end of siding, in top of large sandstone fragment, northeast of tracks; bronze tablet stamped "1109" P. T. Sta. 4 W. Va. 1919	1,109.415
Barnum, 0.9 mile north of, 0.26 mile north of mile-post "C 35," in top of boulder, east of track; chiseled square	1,152.42
Barnum, 0.7 mile north of, top of rail over concrete culvert	1,161.91
Barnum, 0.3 mile north of, 70 feet south of road crossing, in top of boulder, east of track; chiseled circle (W. M. R. R. B. M.)	1,167.48
Barnum, top of rail, opposite station	1,181.12
Barnum, 0.8 mile southeast of, in second step from top, north wing of east abutment of railroad bridge; bronze tablet stamped "1218" P. T. Sta. 5 W. Va. 1919	1,217.976
Big Vein Mine, opposite, top of rail	1,224.7
Shaw, 1 mile north of, 0.27 mile south of mile-post "C 37" in boulder, east of track; chiseled square	1,245.74
Shaw, 0.5 mile north of, top of west rail on overhead road crossing	1,266.96
Shaw, top of east rail opposite station	1,295.17
Shaw, 880 feet south of station, in railroad bridge, south abutment west end of bridge seat; bronze tablet stamped "1299" P. T. Sta. 6 W. Va. 1919	1,299.225
Shaw, 0.8 mile south of, 180 feet east of mile-post "C 39" in top of boulder, east of track; chiseled square	1,330.08
Shaw, 1.8 miles south of, 380 feet south of mile-post "C 40" in south end of top of west abutment of concrete railroad culvert; chiseled square	1,379.90
Neffs, 0.3 mile north of, on concrete railroad culvert, top of east rail	1,400.62
Neffs, 240 feet north of mile-post "C 41" in switch-block; copper nail	1,415.69
Chaffee, opposite station, top of rail	1,476.9
Chaffee, in railroad bridge for branch line over North Branch of Potomac River, north end of east abutment; bronze tablet stamped "1477" P. T. Sta. 7 W. Va. 1919	1,477.400
Chaffee, 1 mile southeast of, 500 feet east of mile-post "C 43," in top of boulder north of track; chiseled square	1,518.11
Blaine, 0.75 mile north of, 500 feet east of coal mine loading stage, in switch-block north of track; copper nail	1,559.90
Blaine, 0.4 mile northwest of, 500 feet east of mile-post "C 45," in fragment of ledge north of track; chiseled square	1,598.73
Blaine, opposite station, top of west rail	1,610.72
Blaine, 800 feet north of station, in top of boulder, about 25 feet east of track; bronze tablet stamped "1604" P. T. Sta. 8 W. Va. 1919	1,604.224
Blaine, 0.6 mile south of, 140 feet south of mile-post "C 46" in boulder, south of track; chiseled square	1,635.68
Potomac Manor, opposite south end of station, top of east rail	1,649.74
Harrison, in south abutment west end of bridge seat of railroad bridge over Abram Creek; bronze tablet stamped "1688" P. T. Sta. 11 W. Va. 1919	1,688.071
Harrison, top of west rail opposite station	1,694.6
Harrison, 0.8 mile south of, 30 feet north of mile-post "C 48" in ledge east of track; chiseled square	1,734.04
Gleason, top of east rail opposite station	1,778.1
Gleason, 0.3 mile south of, 200 feet south of mile-post "C 49" in ledge south of track; chiseled square	1,797.04

	Feet
Hubbard, 0.18 mile north of, in southwest abutment, northwest end of bridge seat of railroad bridge; bronze tablet stamped "1856" P. T. Sta. 10 W. Va. 1919	1,856.887
Hubbard, opposite north end of station	1,871.7

From east border of quadrangle near Keyser, along highways southwest up New Creek to Laurel Dale, thence southeast to east border.

Leveling by E. E. Harris in 1916.

Keyser, 3.0 miles southwest of, in north end of east abutment of concrete culvert over Block Run; bronze tablet stamped "878 W. Va. 1916"	878.263
Keyser, 3.9 miles southwest of, in south end of west stone abutment to highway bridge over New Creek; chiseled square marked "U. S. B. M. 914.1"	914.23
Keyser, 4.9 miles southwest of, in east end of south stone foundation of wooden culvert over Hoffman Run; chiseled square marked "U. S. B. M. 952.5"	952.67
New Creek P. O., on sandstone boulder in front of; chiseled cross marked "971.2"	971.41
New Creek, 0.4 mile southwest of, in south end of bridge seat of west stone abutment of highway bridge over New Creek; bronze tablet stamped "989 W. Va. 1916"	989.348
New Creek, 1.6 miles southwest of, 40 feet west of highway, opposite Wm. Gurd's house, in root of 3-foot sycamore tree; copper nail and washer marked "1039.7 U. S. B. M."	1,039.90
Claysville, in concrete foundation of concrete base of flagpole on east side of highway, half-way between store and house of Henry E. Burgess; chiseled square marked "U. S. B. M. 1088.0"	1,088.24
Claysville, 0.6 mile southwest of, at forks of road on east side of main highway, in large millstone; chiseled square marked "U. S. 1124.2"	1,124.35
Claysville, 1.34 miles southwest of, in north end of top of west abutment of concrete bridge over New Creek; bronze tablet stamped "1153 W. Va. 1916"	1,153.214
Claysville, 2.3 miles southwest of, on east side of highway, 300 feet southwest of Milton Baker's house, in root of 2-foot sycamore tree; copper nail and washer marked "U. S. B. M. 1213.9"	1,214.16
Laurel Dale, in west end of top step of south abutment of concrete bridge over New Creek; bronze tablet stamped "1294 W. Va. 1916"	1,294.719
Laurel Dale, 1.1 miles east of, in Dolls Gap, between Laurel Dale Run and Spring Mill Run, on fragment ledge of sandstone, in trail; chiseled square marked "U. S. B. M. 2032.1"	2,032.52
Laurel Dale, 2.1 miles east of, on north bank of highway, 200 feet northwest of farm house of J. W. Doll, in root of walnut tree; copper nail and washer marked "U. S. B. M. 1381.0"	1,381.38
Laurel Dale, 2.9 miles east of, 100 feet west of road forks, on north side of highway, set in sandstone ledge; bronze tablet stamped "1178 W. Va. 1916"	1,178.722
Laurel Dale, 4.1 miles east of, at road forks, on south side of main highway, 20 feet east of gates in fragment ledge of sandstone; chiseled square marked "1077.4 U. S. B. M."	1,077.66

	Feet.
Laurel Dale, 5.1 miles east of, in north side of road, in root of 2-foot hickory tree; copper nail and washer marked "U. S. B. M. 993.4"	993.73
Laurel Dale, 6.6 miles east of, on north bank of Mikes Run, at road forks, at north end of foot-bridge, in root of sycamore tree; copper nail and washer marked "U. S. B. M. 907.4"	907.63

From Laurel Dale northwest along highways to Schell.

Laurel Dale, 0.7 mile northwest of, in bridge floor over Pokejoy Run; a cross painted "U. S. 1428"	1,430.95
Laurel Dale, 1.0 mile northwest of, on south side of highway at point where highway fords Pokejoy Run, 50 feet northeast of gate to private lane; chiseled square in fragment of sandstone, marked "U. S. B. M. 1491.0"	1,491.41
Laurel Dale, 1.9 miles northwest of, in north side of highway opposite farm house of E. D. Bosely, in fragment of sandstone; chiseled square marked "1857.5 U. S. B. M."	1,857.92
Laurel Dale, 5.3 miles northwest of, 1700 feet southwest of road forks, in north side of highway, in sandstone cliff; bronze tablet stamped "2562 W. Va. 1916"	2,562.941
Laurel Dale, 3.7 miles northwest of, on south side of main highway opposite road forks, in sandstone; chiseled square painted "U. S. B. M. 2720"	2,720.55
Laurel Dale, 4.6 miles northwest of, highest point on highway, painted "2844"	2,844.59
Hartmansville, 0.6 mile southeast of, on north side of highway, in front of Chapel of Hartmansville United Brethren Church; chiseled square on sandstone boulder marked "U. S. B. M. 2745.9"	2,746.53
Hartmansville, 0.4 mile west of, on south side of highway, 100 feet northwest of **Blake Chapel,** where lane turns into farm house of Mrs. Howard Duling, in sandstone fragment; bronze tablet stamped "2677 W. Va. 1916"	2,677.859
Hartmansville, 1.5 miles west of, on north side of highway, 90 feet east of road forks on top of stone set in ground marking boundary-line between Mineral and Grant Counties; chiseled square marked "U. S. B. M. 2595.2"	2,595.88
Hartmansville, 2.9 miles west of, in Grant County, in north end of bridge seat of west abutment of highway bridge over Abram Creek; bronze tablet stamped "2278 W. Va. 1916"	2,278.854
Hartmansville, 4.4 miles west of, in Grant County, on north side of highway, 860 feet east of **Rehoboth Church,** on sandstone boulder; chiseled square marked "U. S. B. M. 2740.0"	2,740.77
Hartmansville, 4.93 miles west of, on north side of main highway, 30 feet east of forks in root of 2-foot white oak tree; copper nail and washer marked "U. S. B. M. 2777.1"	2,777.87
Schell, 1.62 miles east of, on south side of highway, on west end of first stone of farm house of J. G. Hardin; bronze tablet stamped "2648 W. Va. P. T. Sta. 9, 1919"	2,649.160

From point 2.9 miles west of Hartmansville south along highways to south border of quadrangle (Leveled twice).

Primary leveling by Walter McCrea in 1919 and R. G. Stevenson in 1920.

	Feet.
Hartmansville, 2.9 miles west of, in Grant County, in north end of bridge seat of west abutment of highway bridge over Abram Creek; bronze tablet stamped "2,278 W. Va."	2,278.854
Hartmansville, 3.9 miles west of, in Grant County, in large rock, west side of road, 200 feet north of small culvert; chiseled square, marked "T. B. M. 2,513"	2,513.33
Hartmansville, 5 miles west of, in Grant County, on east side of road, on large rock, 250 feet south of small culvert; chiseled cross-mark, marked "T. B. M. 2,777"	2,777.22
Mount Storm, north side of intersection of roads, in large rock; bronze tablet stamped "2,831 W. Va."	2,831.280
Mount Storm, 0.9 mile south of, 150 feet west of Methodist Church, north side of road, in large rock; chiseled square, marked "T. B. M. 2,883"	2,882.85

FLINTSTONE QUADRANGLE.

(Latitude 39° 30′-39° 45′; longitude 78° 30′-78° 45′).

From Patterson Creek south to Alaska P. O. (part of line).

From Bulletin No. 632, page 16; 1916.

Patterson Creek, north end of Baltimore & Ohio R. R. bridge over Patterson Creek, north side of track, in ballast wall; copper plug marked "574 C"	573.887

FROSTBURG QUADRANGLE.

(Latitude 39° 30′-39° 45′; longitude 78° 45′-79°).

From Patterson Creek south to Alaska P. O. (part of line).

Frankfort (Alaska P. O.), 0.5 mile northwest of, in west end of north abutment of highway bridge over Patterson Creek; copper bolt stamped "589 C" (From Bulletin No. 632, page 16; 1916)	588.817
Frankfort (Alaska P. O.), at road crossing, in northeast corner of concrete step of store of J. M. Armstrong; chiseled square marked "U. S. B. M. 604.0" (Leveling by E. E. Harris in 1916)	604.24

GREENLAND GAP QUADRANGLE.

(Latitude 39°-39° 15′; longitude 79°-79° 15′).

From near northwest corner of quadrangle southeast along highways to Scherr (Leveled twice).

Primary leveling by Walter McCrea in 1919 and by R. G. Stevenson in 1920.

Mount Storm, 2.1 miles south of, 250 feet north of private road, west side of road, in root of large white oak tree, marked "T. B. M. 3,000"; copper nail and washer	2,999.56

	Feet.
Mount Storm, 3.2 miles south of, 10 feet north of small culvert, 10 feet west of road, in large boulder; bronze tablet stamped "2,884 W. Va."	2,883.481
Mount Storm, 4.0 miles south of, 300 feet north of dwelling house, 5 feet west of road, in large rock; chiseled cross mark, marked "T. B. M. 2,879"	2,878.87
Mount Storm, 5.1 miles south of, 90 feet south of watering-trough, in large boulder, west side of road; chiseled square, marked "T. B. M. 2,819"	2,820.57
Mount Storm, 6.5 miles south of, 130 feet south of turn in road, in ledge of rocks, north side of road; bronze tablet stamped "2,262 W. Va."	2,261.028
Mount Storm, 7.4 miles south of, 125 feet west of gate to private road, south side of road in rock; chiseled cross mark, marked "T. B. M. 1,889"	1,888.48
Scherr, west end of north abutment of concrete bridge over Elklick Run; chiseled square, marked "T. B. M. 1,551"	1,550.28

From Scherr along highways east to Williamsport thence northeast to northeast corner of quadrangle (Leveled twice).

Primary leveling by F. L. Shalibo and Walter McCrea in 1919.

Greenland, in stone step of post-office; bronze tablet stamped "1,514 W. Va."	1,513.662
Greenland, 1 mile southeast of, 1,800 feet south of iron bridge, in large flat rock, 5 feet west of road; chiseled cross mark, marked "T. B. M. 1,391"	1,389.83
Greenland, 2.0 miles southeast of, 40 feet north of spring, 20 feet west of road, on pointed rock; chiseled cross mark, marked "T. B. M. 1,275"	1,274.68
Falls, 50 feet north of post-office, 10 feet south of cross-roads, in small rock; chiseled cross mark, "T. B. M. 1,257" painted on fence	1,255.95
Falls, 300 feet northeast of, iron bridge over North Fork of Patterson Creek, north side of east abutment; bronze tablet stamped "1,241 W. Va."	1,239.933
Falls, 0.8 mile northeast of, 15 feet southeast of road, 5 feet west of large oak tree, in small boulder; chiseled square, painted "1,224.4"	1,223.65
Falls, 1.6 miles northeast of, opposite T road north, 40 feet from road, near gate to field, in root of large oak tree; copper nail, painted "1,193.1"	1,192.33
Falls, 2.7 miles northeast of, opposite George Reeves's residence, 15 feet northwest of road, in small boulder; bronze tablet stamped "W. Va. 1,129"	1,128.656
Falls, 3.5 miles northeast of, on north edge of road, at small stream crossing, in end of log, at bottom of rail fence; copper nail, painted "1,062.5"	1,061.74
Falls, 4.4 miles northeast of, on northwest corner of wooden bridge, in support; copper nail, painted "1,034.9"	1,034.13
Williamsport, 0.9 mile southwest of, on north end of east abutment of iron bridge over Patterson Creek; bronze tablet stamped "W. Va. 981"	980.442
Williamsport, 150 feet north of post-office, on west edge of road, on south edge of stream crossing, 60 feet south of T road east, in small rock; chiseled square, painted "1,021.6"	1,030.78

Feet.

Williamsport, 0.8 mile north of, in southwest corner of T road west, in gate-post, at corner of fence; iron spike, painted "977.0" 976.13

Williamsport, 1.8 miles north of, at top of hill, 150 feet north of Krous farm house, 70 feet west of road, in large boulder; bronze tablet stamped "W. Va. 970" 969.414

Williamsport, 2.7 miles north of, opposite driveway to D. C. Lyon's residence, 40 feet east of road, near gate to field, in large boulder; chiseled square, painted "955.6" 954.69

Williamsport, 3.8 miles north of, on northwest end of iron bridge over Patterson Creek, on west abutment of bridge; chiseled square, painted "860.5" 859.51

From Scherr southwest along highway to west border of quadrangle.

Primary leveling by Walter McCrea in 1919.

NOTE: An error of 0.6 foot is adjusted in this line between Scherr across Davis Quadrangle to Hopeville, Onego Quadrangle. Line should be releveled.

Scherr, west end of north abutment of concrete bridge over Elklick Run; chiseled square, marked "T. B. M. 1,551" 1,550.28

Scherr, 1.1 miles south of, 5 feet east of road, in large boulder; chiseled cross mark, marked "T. B. M. 1,707" 1,706.40

Scherr, 2 miles south of, 5 feet east of road, in root of black oak tree; copper nail and washer, marked "U. S. G. S. W. Va. T. B. M. 1,891" 1,889.86

Scherr, 3 miles south of, 120 feet south of J. W. Davis's dwelling house, west side of road, in large flat rock; bronze tablet stamped "1,820 W. Va." 1,819.409

Scherr, 4.0 miles south of, 50 feet north of small culvert, 10 feet east of road, in root of white oak tree; copper nail and washer, marked "T. B. M. 1,692" 1,691.04

Scherr, 4.9 miles south of, in southwest corner of concrete steps to Brick Church, west side of road; chiseled square, marked "T. B. M. 1,564" 1,563.52

Scherr, 6.6 miles south of, 150 feet south of gate leading to small dwelling house, in large rock, east side of road; bronze tablet stamped "1,664 W. Va." 1,664.038

Scherr, 7.7 miles south of, 2,500 feet south of **Eureka School**, 10 feet east of road, in root of large oak tree; copper nail and washer, painted "T. B. M. 1,810" 1,809.06

Scherr, 8.6 miles south of, at intersection of roads, west side of root of large white oak tree; copper nail and washer, marked "T. B. M. 1,718" 1,717.97

Scherr, 9.6 miles south of, 2,405 feet west of **Streby Post-Office**, 75 feet east of **Burgess Schoolhouse**, 5 feet west of road, in large flat rock; bronze tablet stamped "1,742 W. Va." 1,741.957

Scherr, 10.6 miles south of, 65 feet south of small culvert, 10 feet north of wood road, east side of road, in rock; chiseled cross marked "T. B. M. 1,929" 1,928.23

From Williamsport southwest along highways to Petersburg (Petersburg Quadrangle).

Primary leveling by F. L. Shalibo in 1919.

Williamsport, 0.9 mile southwest of, on north end of east abutment of iron bridge over Patterson Creek; bronze

	Feet.
tablet stamped "W. Va. 981"	980.442
Williamsport, 1.9 miles southwest of, 0.6 mile northeast of Medley, on west edge of road, in base of 16-inch ash tree; iron spike, painted "1,038.4"	1,037.60
Medley, in northwest corner of concrete bridge over Middle Fork, in base of bridge rail; chiseled square, painted "1,042.5"	1,041.66
Medley, 0.8 mile southwest of, in front of T. W. Michael's residence, in cement block at gate, on west edge of road; chiseled square, painted "1,064.6"	1,063.81
Medley, 1.8 miles southwest of, at T road west, in front of Ernest Naidele's residence, in cement block at gate; bronze tablet stamped "W. Va. 1,108"	1,107.268
Forman, at northeast corner of store, in root of large tree; copper nail, painted "1,116.8"	1,115.98
Lahmansville, in southeast corner of T road east, in front of Snyder Garage, in root of hickory tree; copper nail, painted "1,137.0"	1,136.20
Lahmansville, 1.5 miles southwest of, at top of divide, in southwest corner of road crossing, at northwest corner of Seymour-Snyder Garage, in cement foundation; bronze tablet stamped "W. Va. 1,338"	1,336.712
Lahmansville, 2.5 miles southwest of, at town of **Old Arthur,** 150 feet south of T road east, on west end of small stone culvert, in old log; copper nail, painted "1,149.5"	1,148.72
Lahmansville, 3.8 miles southwest of, opposite T road east, at small stream crossing, on west side of fence, in root of willow tree; copper nail, painted "1,096.0"	1,095.19
Lahmansville, 4.1 miles southwest of, 300 feet south of **Mount Carmel Church,** in south end of stone steps to **Brushy Run School;** bronze tablet stamped "1,112"	1,111.526
Arthur, 250 feet south of Rinehart's store, in center of road forks, in root of two-foot oak tree; copper nail, painted "1,070.2"	1,069.44
Seymourville, 250 feet north of store, in southeast corner of bridge over Brushy Run, in wooden support; copper nail, painted "1,028.5"	1,027.66
Seymourville, 1.1 miles southwest of, at west end of bridge over Lunice Creek, in south abutment; bronze tablet stamped "W. Va. 1,008"	1,006.724
Petersburg, 3.2 miles north of, on northwest corner of small concrete bridge; chiseled square, painted "990.1"	989.27
Petersburg, 2.3 miles north of, on east edge of road, in root of large tree; copper nail, painted "977.3"	976.47
Petersburg, 1.1 miles north of, opposite T road west, in top of fence support stake; copper nail, painted "1,024.2"	1,023.40

From Forman east along highway to east border of quadrangle. Line enters Moorefield Quadrangle.

Forman, 1.0 mile east of, 70 feet west of gate to mountain cabin, on north edge of road, in root of large tree; copper nail, painted "1,360.4"	1,359.64
Forman, 2.1 miles east of, at top of mountain, in front of log cabin, on north edge of road, north side of fence, in root of apple tree; copper nail, painted "1,758.2"	1,757.35
Forman, 3.0 miles east of, at second-class T road northeast, 10 feet north of east gate-post, in ledge of rock; bronze tablet stamped "W. Va. 1,711"	1,710.170

	Feet.
Forman, 3.7 miles northeast of, on second-class road, 100 feet northeast of T road northwest, on west edge of road, in root of large ash tree; copper nail, painted "1,568.7"	1,567.92
Forman, 4.5 miles northeast of, on second-class road, opposite T road north, 15 feet south of road, in root of 16-inch maple tree; copper nail, painted "1,441.2"	1,440.42

From west border of Moorefield Quadrangle southwest and west along Baltimore and Ohio Railroad to Petersburg. Line leaves Greenland Gap Quadrangle and jogs into Petersburg Quadrangle.

Moorefield, 4.0 miles south of, on Baltimore and Ohio Railroad, on northwest corner of bridge No. 574, in wooden support; copper nail, painted, "838.8"	837.88
Moorefield, 5.2 miles south of, on Baltimore and Ohio Railroad, 120 feet north of bridge No. 577, in wooden support at cattle-guard, on east edge of track; copper nail, painted "853.3"	852.32
Petersburg, 3.6 miles east of, 20 feet south of track, at farm road crossing, in base of telephone-pole; iron spike, painted "894.9"	893.89
Welton Station, on Baltimore and Ohio Railroad, on east railroad tie, at switch-lever; copper nail, painted "902.0"	900.99

From point 5.2 miles east of Hopeville east along highways near south border of quadrangle to near Petersburg.

Primary leveling by Walter McCrea in 1919.

Hopeville, 5.2 miles east of, north side of road, in front of W. H. Kiles' dwelling, in concrete walk; bronze tablet stamped "1,122 W. Va."	1,121.941
Hopeville, 6.1 miles east of, at intersection of roads, north side, in rock; chiseled cross mark, marked "T. B. M. 1,034"	1,033.86
Hopeville, 7.1 miles east of, 200 feet east of private road leading to north, 5 feet south of road, in root of oak tree; copper nail and washer, tree marked "T. B. M. 998"	997.62
Hopeville, 8.0 miles east of, 0.5 mile west of Patterson Creek road, on North Fork turnpike, south of road, in root of hickory tree; copper nail and washer, tree marked "T. B. M. 1,086"	1,085.40
Petersburg, 1.1 miles north of, opposite T road west, in top of fence support stake; copper nail and washer; post marked "1,024.2 T. B. M."	1,023.40

KEYSER QUADRANGLE.

(Latitude 39° 15′-39° 30′; longitude 78° 45′-79°).

From Keyser southwest along highway to west border of quadrangle.

Leveling by E. E. Harris in 1916.

Keyser, near center of Keyser yards, opposite old mile-post "202," section of rail set vertically in ground; B. & O. B. M. marked "23"	827.000

Feet.

Keyser, opposite telegraph-pole 201-8, between tracks, in south abutment of bridge over New Creek; copper bolt; B. & O. B. M. 22 (Bull. 632, p. 145) 800.700

Keyser Court-House, in east end of second concrete step; bronze tablet stamped "809 W. Va. 1916" 809.020

Keyser, 1.0 mile southwest of, in northwest end of concrete culvert over small run, just south of road forks; chiseled square marked "824.7 U. S. B. M." 824.77

Keyser, 2.1 miles southwest of, in northwest corner of culvert over Stony Run; chiseled square marked "859.4 U. S. B. M." 859.43

From point in west border of quadrangle east of Laurel Dale, along highways east and northeast down Patterson Creek to Frankfort (Alaska P. O.).

Laurel Dale, 7.9 miles east of, 30 feet north of highway, 250 feet south of farm house of J. B. Rawlings, in root of large white oak tree, 3 feet in diameter; marked "882.8," copper nail 883.09

Burlington, 4.4 miles southwest of, 900 feet north of road forks, in center of top rail (west) of concrete bridge over Mikes Run; bronze tablet stamped "807 W. Va. 1916" 807.390

Burlington, 3.3 miles southwest of, on west side of highway, 350 feet south of point where small run crosses road, in root of 2.5-foot white oak tree; copper nail and washer marked "U. S. B. M. 852.8" 853.05

Burlington, 2.5 miles southwest of, on west side of highway at road forks, in west end of south abutment of wooden bridge over small run; bronze tablet set vertically, stamped "787 W. Va. 1916" 787.464

Burlington, 0.8 mile southwest of, on west side of highway, 200 feet west of farm house, in 3½-foot white oak tree; copper nail marked "U. S. B. M. 756.3" 756.48

Burlington, set in west end of bridge seat of north abutment of highway bridge over Mill Run; bronze tablet stamped "739 W. Va. 1916" 739.029

Mill Run, surface of water under above bridge 733.6

Patterson Creek, at point where highway crosses creek, surface of water, August 15, 1916 ..... 724.2

Burlington, 1.4 miles northeast of, in east side of highway, in front of farm house of I. I. Whipp, in root of stump 8 feet high; copper nail and washer marked "U. S. B. M. 725.3" 725.54

Burlington, 2.3 miles northeast of, in west end of north bridge seat of wooden bridge over Johnson Run; chiseled square marked "U. S. B. M. 713.1" 713.33

Burlington, 3.3 miles northeast of, 80 feet south of road forks, in north end of east concrete foundation of wooden bridge over small run; bronze tablet stamped "709 W. Va. 1916" 708.893

Headsville, 1.0 mile southwest of, 600 feet north of farm house of Maple Hill farm, east side of highway in east end of lower north parallel support of wooden bridge over small run; copper nail and washer marked "U. S. B. M. 695.1" 695.25

Headsville, 0.2 mile east of post-office, set in east end of north bridge seat of highway bridge over Patterson Creek;

	Feet.
bronze tablet stamped "685 W. Va. 1916"	685.210
Headsville, 1.0 mile north of, on highest point of road, just south of road forks, on west side of highway, in root of large oak tree; copper nail and washer marked "U. S. B. M. 908.2"	908.42
Headsville, 2.33 miles north of, 350 feet north of farm house, in north end of west concrete abutment of wooden bridge over small run; chiseled square marked "U. S. B. M. 674.7"	674.89
Reeses Mill, 0.16 mile north of, set on east end of south bridge seat of highway bridge over Patterson Creek; bronze tablet stamped "655 W. Va. 1916"	655.077
Reeses Mill, 1.22 miles north of, 30 feet west of road, 500 feet north of farm house, in root of walnut tree 3 feet in diameter; copper nail and washer marked "U. S. B. M. 647.8"	648.03
Champwood, 0.24 mile south of, in east end of north abutment of concrete culvert over small run; chiseled square marked "U. S. B. M. 641.4"	641.55
Champwood, 1.67 miles north of, in east end of north abutment of concrete culvert over small run; bronze tablet stamped "628 1916 W. Va."	628.569
Champwood, 2.81 miles north of, west side of highway, directly in front of farm house, in root of large walnut tree; copper nail and washer marked "U. S. B. M. 622.9"	623.09
Champwood, 3.84 miles north of, set in north end of east abutment of concrete culvert over Sulphur Spring Run; bronze tablet stamped "646 1916 W. Va."	646.022
Frankfort, 1.13 miles south of, in front of farm house, in west side of highway, in root of stump 10 feet high; copper nail and washer marked "U. S. B. M. 608.4"	608.60

From Headsville northeast along highways to Keyser.

Headsville P. O., on pointed sandstone; chiseled cross marked "U. S. 682.6"	682.71
Headsville, 1.5 miles northwest of, north side of highway, 60 feet east of stream crossing on south bank of Staggs Run, directly in front of farm house of R. Ludwig, in stump at south end of foot-bridge; copper nail and washer marked "U. S. B. M. 756.5"	756.71
Headsville, 2.0 miles northwest of, 30 feet south of highway 60 feet northeast of house, east side of north concrete support of wooden bridge over drain; chiseled square marked "U. S. B. M. 799.2"	799.38
Headsville, 2.4 miles northwest of, south side of highway in front of residence of D. C. Parish, on top in center of south wall of concrete culvert over small run; bronze tablet stamped "909 W. Va. 1916"	908.843
Headsville, 3.0 miles northwest of, in low gap between fork of Cabin Run and Staggs Run; chiseled cross marked "U. S. 1119"	1,119.26
Headsville, 3.2 miles northwest of, at road forks on north side of main highway, in root of hickory tree; copper nail and washer marked "U. S. B. M. 986.8"	986.96
Fountain, in west end of north wall of concrete bridge over Cabin Run; bronze tablet set vertically, stamped "811 1916 W. Va."	811.343

	Feet.
Fountain, 0.90 mile northwest of, at forks of lane north, on north side of main highway; chiseled square in sandstone ledge marked "U. S. B. M. 1094.3"	1,094.46
Keyser, 2.00 miles southeast of, in **Hammick's Gap,** on north side of highway, in fragment ledge of limestone; chiseled square marked "U. S. B. M. 1350.8"	1,351.05
Keyser, 1.26 miles southeast of, on north side of highway at road forks, opposite private lane, in root of south tree of twin white oak trees; copper nail and washer marked "U. S. B. M. 933.2"	933.43

From southwest corner of quadrangle northeast along highways to bridge over Mikes Run (Leveled twice).

Primary leveling by F. L. Shalibo and Walter McCrea in 1919.

Williamsport, 4.7 miles north of, on east edge of road and near rail fence, opposite **T** road southwest, 50 feet north of stream, in cement post; bronze tablet stamped "850 W. Va."	849.500
Williamsport, 5.6 miles north of, on west edge of road, opposite field gate, 50 feet north of small stream, in root to twin trees; copper nail, painted "844.6"	843.61
Williamsport, 6.8 miles north of, at **T** road west, on southeast corner of cement culvert; chiseled square, painted "827.6"	826.50
Burlington, 4.4 miles southwest of, 900 feet north of road forks, in center of top rail, west, of concrete bridge over Mikes Run; bronze tablet stamped "W. Va. 807"	807.390

From Burlington east along highway to Junction (Leveled twice).

Primary leveling by F. L. Shalibo in 1920.

Burlington, in west end of bridge seat of north abutment of highway bridge over Mill Run; bronze tablet stamped "739 W. Va. 1916"	739.029
Burlington, 0.8 mile east of, 165 feet east of **T** road south, 100 feet west of **T** road north, on northeast corner of cement bridge over small stream; chiseled square, marked "745.7"	745.66
Burlington, 1.9 miles east of, 2.2 miles west of **Junction,** on east edge of **T** road north, in root of 12-inch oak tree; copper nail, marked "849.2"	849.11
Burlington, 2.8 miles east of, 1.3 miles west of **Junction,** 30 feet east of **T** road north, 20 feet north of main road, 1 foot from fence, in top of old tree stump; copper nail, marked "838.2"	837.60
Burlington, 4.1 miles east of, 7 miles west of Romney, 560 feet east of store, at **Junction,** on south edge of road, in top of mile-stone; bronze tablet stamped "W. Va. 1920 775"	774.192

From Junction southwest along highways to Moorefield Quadrangle.

Junction, 1.3 miles southwest of, 40 feet north of wooden bridge, 60 feet north of **T** road west, on east edge of road, in root of 14-inch oak tree; copper nail, marked "804.6"	804.05

	Feet.
Junction, 2.2 miles southeast of, 60 feet southeast of farm house, in southeast corner of cement bridge over small stream; chiseled square, marked "825.9"	825.32
Junction, 3.1 miles southeast of, at **T** road west in southeast corner of cement foundation of house; bronze tablet stamped "W. Va. 1920 842"	841.825
Junction, 4.1 miles southeast of, 0.3 mile north of **Rada P. O.,** 2.8 miles north of **Purgitsville,** 20 feet west of road, in root of hickory tree; copper nail, marked "872.6"	872.04
Junction, 5.0 miles southeast of, 0.6 mile east of **Rada P. O.,** 1.9 miles north of **Purgitsville,** 40 feet south of farm house, at fence line, 30 feet west of road, in root of large tree; copper nail, marked "881.7"	881.12
Junction, 5.9 miles southeast of, 1.0 mile north of **Purgitsville,** in southwest corner of cement bridge over small stream, in top of guard-rail; bronze tablet stamped "W. Va. 906 1920"	905.368

OAKLAND QUADRANGLE.

(Latitude 39° 15′-39° 30′; longitude 79° 15′-79° 30′).

From Oakland south to Redhouse, thence east to Gorman, thence north through Kearney and Deer Park to Mountain Lake, Maryland.

From Bulletin No. 563 pages 45-46; 1914.

Redhouse, southwest corner-stone of school building; aluminum tablet stamped "2557 C"	2,556.966
Redhouse, 2.6 miles east of, at four corners on top of Backbone Mountain, (near **Table Rock**), 10 feet south of spring, on boulder; chiseled square	3,073.58
Gorman, highway bridge over North Branch of Potomac River, at west end of north abutment; aluminum tablet stamped "2312 C"	2,312.294
Kearney, 2.2 miles northeast of, 900 feet west of **Tasker Corners,** 600 feet east-southeast from barn in Jerry Tasker's upper field; aluminum tablet stamped "2720 C"	2,720.351
Deer Park, between two Baltimore & Ohio Railroad stations; 725 feet east of Deer Park Hotel Station, top of southwest wing-wall of abutment of stone culvert; aluminum tablet stamped "2447 C"	2,447.184
Mountain Lake, 3 miles east of Oakland, railroad bridge over Little Youghiogheny River, on top of southwest corner of west abutment; point marked "B □ M" (C. & G. S. B. M. XXII)	2,404.324

Near Schell on Western Maryland Railroad.

Leveling by K. F. Maxcy in 1916.

Schell, 1.12 miles north of, 0.25 mile south of mile-post "C 51" in sandstone ledge east of track; chiseled square	1,931.17
Schell, 0.3 mile north of, 90 feet south of mile-post "C 52" in fragment of ledge west of track; chiseled square	1,979.92
Schell, opposite station, top of east rail	1,997.7

	Feet.
Schell, 0.75 mile south of, 42.5 feet northwest of mile-post "C 53" 16 feet west of track, in fragment of ledge; bronze tablet stamped "2040"	2,040.218
Schell, 1.44 miles southwest of, in railroad bridge over North Branch of Potomac River, in east end of north abutment; chiseled square	2,081.82
North Branch of Potomac River, water-level June 28, 1916	2,061.5

From Bayard southwest along Western Maryland Railroad to Dobbin.

Bayard Station, 750 feet north of, in west end of bridge seat, south abutment of railroad bridge over North Branch of Potomac River; bronze tablet stamped "2342"	2,342.337
Top of west rail opposite **Bayard Station**	2,345.72
Bayard, 1 mile south of, in switch-block east of track; copper nail	2,407.14
Wilson, 0.8 mile north of, in top of south end of stone culvert, west of track; chiseled square	2,449.16
Wilson, 1200 feet south of, in front of mile-post "C 65" in top of small boulder; chiseled square	2,516.36

ONEGO QUADRANGLE.

(Latitude 38° 45′-39°; longitude 79° 15′-79° 30′).

Primary leveling by Walter McCrea in 1919.

From near east border of quadrangle over divide from North Mill Creek to Upper Tract on South Branch of Potomac River.

Brushy Run Post-Office, 0.3 mile north of, 120 feet north of **Wilson Church**, west side of road, in root of large oak tree; copper nail and washer, tree marked "T. B. M. 1,379"	1,377.64
Brushy Run P. O., 0.6 mile southwest of, south side of road, in stone step to John Miller's dwelling; chiseled cross, marked "T. B. M. 1,607"	1,606.22
Brushy Run P. O., 1.4 miles southwest of, 50 feet south of gate leading to E. M. Kyle's farm, 200 feet south of **Kyle Schoolhouse**, in east side of road, in ledge of rock; bronze tablet stamped "1,523 W. Va."	1,521.770
Brushy Run P. O., 2.4 miles southwest of, west abutment, north end of steel bridge over South Branch of Potomac River; chiseled square, bridge marked "T. B. M. 1,422"	1,420.82
Brushy Run P. O., 3.4 miles southwest of, 70 feet southwest of small shanty, side of road, in large rock; chiseled square, marked "T. B. M. 1,502"	1,500.91
Upper Tract Post-Office, 0.4 mile south of, 5 feet north of south door of schoolhouse, in small rock; bronze tablet stamped "1,495 W. Va."	1,494.254

From east border of quadrangle northwest along highways to Upper Tract.

Primary leveling by F. L. Shalibo in 1919.

Upper Tract, 1.7 miles east of, at second class T road north, in northeast corner of forks, in root of walnut tree; copper nail, painted "1,486.3"	1,485.51

Feet.

Upper Tract, 1.2 miles east of, on cement bridge over South Branch of Potomac River, on west end of north rail; chiseled square, painted "1,435.2" 1,434.41

Upper Tract, 0.4 mile south of post-office, 5 feet north of south door of schoolhouse, in small rock; bronze tablet stamped "W. Va. 1,495" 1,494.254

From Upper Tract along highways southwest 6 miles up Reeds Creek, thence west over North Fork Mountain to Riverton, thence northeast down North Fork of South Branch of Potomac River to Mouth of Seneca (Leveled twice).

Primary leveling by Walter McCrea in 1919.

Upper Tract, 1.4 miles southwest of, 500 feet southeast of William Halloway's dwelling, north side of road, at ford crossing, in large rock; chiseled square "T. B. M. 1,586" painted on rock 1,584.74

Upper Tract, 2.6 miles southwest of, 2,000 feet south of small dwelling house, west side of road, in root of large maple tree; copper nail and washer, "T. B. M. 1,667" marked on tree 1,665.68

Upper Tract, 4.1 miles southwest of, northeast end of dwelling on Gardner Bogg's farm, 100 feet west of road, in base of chimney; bronze tablet stamped "1,776 W. Va." 1,774.313

(Three lines omitted here are in Circleville Quadrangle).

Upper Tract, 8.1 miles southwest of, northeast side of road, in large boulder; chiseled cross mark, "T. B. M. 2,965" on rock 2,962.46

Upper Tract, 9.0 miles southwest of, northwest side of road, in large flat rock; chiseled square, "T. B. M. 2,905" painted on rock 2,903.13

Upper Tract, 9.9 miles southwest of, 10 feet east of intersection of roads, south side, in large flat rock; bronze tablet stamped "2,273 W. Va." 2,270.593

Upper Tract, 10.9 miles southwest of, south side of road, in root of large chestnut tree; copper nail and washer, "T. B. M. 2105" painted on tree 2,102.69

Upper Tract, 11.09 miles southwest of, 200 feet south of Paul Pheris's dwelling, south side of road, in root of white oak tree; copper nail and washer, "T. B. M. 2110" painted on tree 2,107.47

(Two bench marks omitted here are in Circleville Quadrangle).

Riverton, 1 mile northeast of, at intersection of roads, northwest end of wooden bridge, in support log; copper nail and washer, "T. B. M. 1,776" painted on bridge..... 1,773.89

Riverton, 2.4 miles northeast of, 150 feet north of Sarah E. Herman's barn, 10 feet east of road, in large flat rock; bronze tablet stamped "1,749 W. Va." 1,746.655

Riverton, 3.5 miles northeast of, 10 feet west of road, in large chestnut stump; copper nail and washer, painted "T. B. M. 1,743" 1,740.34

Riverton, 4.4 miles northeast of, 845 feet north of T road,

	Feet.
east of road, in large rock; chiseled square, "T. B. M. 1,675," painted on fence-post	1,673.05
Macksville, 30 feet north of post-office, 5 feet west of road, in large flat rock, bronze tablet stamped "1,627 W. Va."	1,625.091
Macksville, 0.9 mile northeast of, 100 feet north of T road, southwest end of wooden bridge; copper nail and washer, marked "T. B. M. 1,623"	1,620.79
Macksville, 2.0 miles northeast of, west side of road, in root of large oak tree; copper nail and washer, marked "T. B. M. 1,597"	1,594.36
Mouth of Seneca, 200 feet north of post-office, at intersection of roads, in large boulder; bronze tablet stamped "1,569 W. Va."	1,566.588

From Mouth of Seneca northeast along road down North Fork of South Branch of Potomac River to point 2.6 miles southwest of Hopeville.

Mouth of Seneca, 1.0 mile north of, in triangle, in center of road, small rock; chiseled square, "T. B. M. 1,518" painted on post	1,515.32
Mouth of Seneca, 1.9 miles northeast of, west side of road, at gate, in root of large oak tree; copper nail and washer, "T. B. M. 1,524" painted on tree	1,521.61
Mouth of Seneca, 3.3 miles northeast of, 800 feet south of road leading west, west side of road, in flat rock; bronze tablet stamped "1,473 W. Va."	1,470.701
Mouth of Seneca, 4.6 miles northeast of, 30 feet west of Sawmill Run, 15 feet south of road, in root of large sycamore tree; copper nail and washer, "T. B. M. 1,425" painted on tree	1,422.43
Mouth of Seneca, 5.6 miles northeast of, 60 feet south of Mount Pleasant U. B. (Pleasant Valley) Church, 10 feet west of road, in large boulder; chiseled cross mark, "T. B. M. 1,476"	1,473.39
Mouth of Seneca, 6.7 miles northeast of, 70 feet south of Carr Schoolhouse, 40 feet west of road, in large pointed boulder; bronze tablet stamped "1,694 W. Va."	1,691.397
Mouth of Seneca, 7.7 miles northeast of, 30 feet south of Zeke Run, 10 feet east of road, in large boulder; chiseled square, marked "T. B. M. 1,587"	1,584.68
Mouth of Seneca, 8.7 miles northeast of, 500 feet southwest of Will Heavner's dwelling, east side of road, in south end of wooden culvert; copper nail and washer, "T. B. M. 1,446" on fence	1,443.06
Mouth of Seneca, 9.8 miles northeast of, 375 feet west of High Ridge Run, 10 feet south of road, in large boulder; bronze tablet stamped "1,379 W. Va."	1,376.333
Mouth of Seneca, 10.9 miles northeast of, west side of road, in small rock; chiseled square, "T. B. M. 1,529" painted on tree	1,526.38
Mouth of Seneca, 11.9 miles northeast of, 800 feet north of Long Hollow School, east side of road, in root of large oak tree; copper nail and washer, marked "T. B. M. 1,346"	1,343.14

From north border of quadrangle south to Hopeville.

(Part of line from Scherr in which an error of 0.6 foot has been adjusted in Greenland Gap, Davis, and Onego Quadrangles).

	Feet.
Scherr, 15.6 miles south of, 700 feet south of point where road crosses Jordan Run, at turn in road, west side of road, in large flat rock; bronze tablet stamped "1285 W. Va."	1,284.254
Scherr, 16.6 miles south of, 25 feet south of private road, at entrance to Hopeville Gap, west side of road, in large flat rock; chiseled square, rock marked "T. B. M. 1,385"	1,384.87

From Hopeville east along highway.

(Line enters Petersburg Quadrangle).

Hopeville, 1.5 miles northeast of, 15 feet west of Jordan Run, 115 feet south of Perry Robaugh's dwelling, in root of large sycamore tree; copper nail and washer, "T. B. M. 1,106" marked on tree	1,105.44

From point 2.6 miles southwest of Hopeville along highways northeast to Hopeville (Leveled twice).

New Hopeville, 1.0 mile southwest of, 180 feet north of Red Creek road, west side of road, in large rock; bronze tablet stamped "1,477 W. Va."	1,474.401
Hopeville, southeast of Amos Dolly's storehouse, north side of road, in root of large maple tree; copper nail and washer, "T. B. M. 1,152" painted on tree	1,149.18
Hopeville, 1.3 miles northeast of, opposite Hopeville Schoolhouse, east of road, in root of large poplar tree; copper nail and washer, marked "T. B. M. 1,122"	1,119.11
Hopeville, 1.5 miles northeast of, 15 feet west of Jordan Run, 115 feet south of Perry Robaugh's dwelling, south of road, in root of large sycamore tree; copper nail and washer, "T. B. M. 1,106" on tree	1,105.438

From Mouth of Seneca along highways northwest to Days Mills (Harperton P. O.).

(Line enters Horton Quadrangle).

Mouth of Seneca P. O., 200 feet north of post-office, at intersection of roads, in large boulder; bronze tablet stamped "1,569 W. Va."	1,566.588
Mouth of Seneca P. O., 1.0 mile west of, north side of road, in large rock; chiseled square, "T. B. M. 1,748" painted on rock	1,745.55
Mouth of Seneca P. O., 2 miles west of, 400 feet west of road leading south, south side of road, in large boulder; chiseled square, "T. B. M. 1,757" painted on boulder	1,754.88
Onego, 30 feet north of J. R. Adamson's store, 100 feet south of Roaring Creek, east side of road, in large boulder; bronze tablet stamped "1,764 W. Va."	1,761.139
Onego, 1.0 mile northwest of, opposite Luther Hoffman's dwelling, 15 feet west of road, in large flat rock; chiseled	

	Feet.
square, marked "T. B. M. 1,841"	1,838.82
Onego, 2.0 miles northwest of, north side of road, in large boulder; chiseled square, boulder marked "T. B. M. 1,929"	1,926.88
Onego, 3.1 miles northwest of, 500 feet south of wooden bridge over McIntosh Run of Horsecamp Run, east side of road, in large flat rock; bronze tablet stamped "2,170 W. Va."	2,167.501
Onego, 4.1 miles northwest of, in ledge of rocks, east side of road; chiseled square, "T. B. M. 2,661" painted on rocks	2,658.71
Onego, 5.2 miles northwest of, 700 feet south of road leading east, west side of road, in small rock; chiseled square, "T. B. M. 3,212" painted on telephone-pole	3,209.06
Onego, 6.4 miles northwest of, 250 feet east of road leading south, north of road, in large boulder; bronze tablet stamped "2,977 W. Va."	2,974.180
Harperton P. O., 15 feet west of J. C. Harman and Company's store, north side of road, in large boulder; chiseled square, "T. B. M. 2,752" painted on boulder	2,750.02

From west border of quadrangle east along highways to point 1.0 mile southwest of New Hopeville.

Red Creek Junction, 1.8 miles southeast of, at gate leading to J. W. Mullennux's farm, 100 feet west of Big Run, south side of road, in flat rock; bronze tablet stamped "2,355 W. Va."	2,352.915
Red Creek Junction, 2.9 miles east of, 550 feet east of Henry Hoffman's dwelling, north side of road; chiseled square, painted "T. B. M. 2,325" on fence-post	2,322.23
Red Creek Junction, 4.0 miles east of, south side of railroad grade, in root of large beech tree; copper nail and washer, marked "T. B. M. 2,358"	2,355.85
Laneville, 100 feet west of post-office, 125 feet north of road, in large pointed rock; bronze tablet stamped "2,516 W. Va."	2,513.758
Laneville, 1.1 miles east of, south side of Red Creek, at road crossing in large rock; chiseled square, painted "T. B. M. 2,612"	2,609.27
Laneville, 2.1 miles east of, on Red Creek road, south side, in large flat rock; chiseled square, painted "T. B. M. 2,997"	2,994.39
New Hopeville, 7.4 miles west of, on Red Creek road, north side of road, in large boulder; chiseled square, "T. B. M. 3,734" painted on rock	3,731.22
New Hopeville, 7.1 miles west of, on Red Creek road, on National Forest Reservation, north side of road, in large boulder; bronze tablet stamped "3,888 W. Va."	3,885.700
New Hopeville, 6.1 miles west of, on Red Creek road, 50 feet east of Big Spring, north side of road, in large boulder; chiseled square, "T. B. M. 3,919" on rock	3,916.29
New Hopeville, 5.1 miles west of, on Red Creek road, 1,000 feet north of woods road, west side, in large rock; chiseled square, "T. B. M. 3,368" painted on rock	3,365.68
New Hopeville, 4.1 miles west of, on Red Creek road, 1,500 feet west of Robert Havener's cabin, south side of road, in large rock; bronze tablet stamped "2,838 W. Va."	2,835.037

	Feet.
New Hopeville, 3.1 miles west of, on Red Creek road, north side, in large ledge of rocks; chiseled square, marked "T. B. M. 2,442" on rocks	2,438.88
New Hopeville, 2.1 miles southwest of, on Red Creek road, south side, in ledge of rocks; chiseled cross, marked "T. B. M. 1,927"	1,924.53
New Hopeville, 1.0 mile southwest of, 180 feet north of Red Creek road, west side of road, in large flat rock; bronze tablet stamped "1,477 W. Va."	1,474.401

From Upper Tract south along highways into Circleville Quadrangle.

Primary leveling by E. E. Harris in 1921.

Brushy Run, 3.4 miles southwest of, 70 feet southwest of small shanty, side of road, in large rock; chiseled square, marked "T. B. M. 1,502"	1,500.91
Upper Tract Post-Office, 0.4 mile south of, 5 feet north of south door of schoolhouse, in small rock; bronze tablet stamped "1,495 W. Va."	1,494.254
Upper Tract Post-Office, 1.22 miles south of, on west edge of road, in south root of oak tree, 5 feet in diameter; copper nail and washer, fence marked "U. S. 1,482.8 B. M."	1,482.85
Upper Tract Post-Office, 2.19 miles south of, on west edge of road, in front of home of Joe Alt, in south root of 36-inch oak tree; copper nail and washer, fence marked "U. S. 1,501.1 B. M."	1,501.15
Upper Tract Post-Office, 2.79 miles south of, 2.92 miles north of **Ruddle**, 50 feet west of road center, 30 feet south of **T** road east, in top of concrete post; bronze tablet stamped "W. Va. 1921 H 71," fence marked "U. S. 1,488.9 B. M."	1,488.930
Witness bench mark, N. 60° E. of tablet, in south root of 18-inch walnut tree; copper nail and washer	1,485.98

PETERSBURG QUADRANGLE.

(Latitude 38° 45′-39°; longitude 79°-79° 15′).

Primary leveling by Walter McCrea in 1919.

From near Hopeville, Onego Quadrangle, northeast along highways near north border of quadrangle into Greenland Gap Quadrangle northwest of Petersburg.

Hopeville, 1.3 miles east of, 500 feet east of road leading to Joseph Turner's farm, 5 feet north of road, in large rock; bronze tablet stamped "1,244 W. Va."	1,243.348
Hopeville, 2.5 miles east of, 1,500 feet east of two small shanties, 15 feet north of road, in large flat rock; chiseled cross mark, "T. B. M. 1,081" marked on stone	1,081.12
Hopeville, 3.6 miles east of, 150 feet east of wooden bridge, north side of road, on large rock; chiseled cross mark, stone marked "T. B. M. 1,055"	1,054.81

From near northeast corner of quadrangle west along Baltimore and Ohio Railroad to Petersburg.

Primary leveling by F. L. Shalibo in 1919.

	Feet.
Moorefield, 6.3 miles south of, 500 feet east of Spring Brook flag-station, on Baltimore and Ohio Railroad, in concrete foundation of silo; bronze tablet stamped "W. Va. 859"	858.195
Moorefield, 7.2 miles south of, on Baltimore and Ohio Railroad, 6.0 miles east of Petersburg, at small stream crossing, on east edge of track, in top of cement culvert; chiseled square, painted "876.9"	875.59
Petersburg, 5.0 miles east of, on Baltimore and Ohio Railroad, at **Durgon Station,** in north end of west bent of bridge 583; iron pin, painted "876.9"	875.91
Petersburg, 4.5 miles east of, 300 feet south of track, in base of cement silo, at Seymour Fisher's residence; bronze tablet stamped "W. Va. 893"	891.992
Petersburg, 2.0 miles east of, on Baltimore and Ohio Railroad, at west end of Petersburg Gap, at sharp curve on south edge of track, in ledge of rock; chiseled square, painted "914.8"	913.80
Petersburg, 1.5 miles east of, in northeast corner of wooden bridge over Mill Creek, in wooden support; copper nail, painted "913.5"	912.44
Petersburg, 400 feet west of railroad station, in center of north timber of base of water-tank; copper nail, painted "936.0"	935.20
Petersburg, at north end of Main Street, in base of water-tank, on west side; bolt, painted "1,037.0"	1,036.21
Petersburg, 50 feet west of court-house, 50 feet south of road, in cement block; bronze tablet stamped "W. Va. 938"	936.957

From Petersburg southwest along highways to west border of quadrangle.

Primary leveling by Walter McCrea in 1919.

(Line enters Onego Quadrangle).

Petersburg, at railroad crossing, at station; top of south rail	932.3
Petersburg, 1.1 miles southwest of, northwest side of road, in root of sycamore tree; copper nail and washer, tree marked "T. B. M. 1,000"	999.56
Petersburg, 2 miles southwest of, 50 feet north of Ben. Jenkins's dwelling, on west side of road, on small ledge of rocks; chiseled square, "T. B. M. 1,101," marked on post	1,100.47
Petersburg, 3.1 miles southwest of, north end of east side of concrete bridge over small stream; bronze tablet stamped "1,086 W. Va."	1,085.470
Petersburg, 3.9 miles southwest of, north side of road, in large iron culvert; chiseled cross, marked "T. B. M. 1,018"	1,017.47
Petersburg, 4.7 miles southwest of, at gate leading to field of J. Ed. Bergdoll, east side of road, in root of cedar tree; copper nail and washer, marked "T. B. M. 1,040"	1,038.90
Petersburg, 5.7 miles southwest of, south abutment of east side of concrete bridge over North Mill Creek; bronze tablet stamped "1,051 W. Va."	1,050.492

	Feet.
Pansy P. O., 0.5 mile south of, east side of road, opposite gate to field, in root of large oak tree; copper nail and washer, tree marked "T. B. M. 1,093"	1,091.67
Pansy P. O., 1.4 miles south of, 290 feet west of **Landes P. O.**, in south end of wooden bridge; copper nail and washer, marked "T. B. M. 1,129"	1,128.00
Landes P. O., 1.6 miles southwest of, 50 feet southeast of O. B. Kimble's dwelling, east side of road, in flat rock over culvert; bronze tablet stamped "1,155 W. Va."	1,154.287
Landes P. O., 2.8 miles southwest of, east side of road, opposite gate to field, in root of pine tree; copper nail and washer, marked "T. B. M. 1,210"	1,208.58
Landes P. O., 3.6 miles southwest of, 120 feet south of Lige Judy's dwelling, northwest side of road, on large rock; chiseled square, marked "T. B. M. 1,226"	1,225.17
Landes P. O., 4.6 miles south of, at Alt Schoolhouse, 80 feet north of road, in southeast end of stone foundation; bronze tablet stamped "1,246 W. Va."	1,245.430

From Petersburg along highways south to Wine Spring School thence northeast to east border of quadrangle.

Primary leveling by F. L. Shalibo in 1919.

Petersburg, 1.0 mile south of, on Turkey Knob road, in southwest corner of bridge over small run, in stone abutment; chiseled square, painted "974.8"	973.95
Petersburg, 1.7 miles south of, on Turkey Knob road, at three corners, in northwest corner of forks, in root of small tree; copper nail, painted "1,164.4"	1,163.64
Petersburg, 2.9 miles south of, at country store, 150 feet west of road, under south sill at stable door of Isaac Shobe's barn; bronze tablet stamped "W. Va. 944"	943.393
Petersburg, 3.6 miles south of, on west edge of road, opposite **T** road east, in root of large tree; copper nail, painted "969.1"	968.32
Petersburg, 4.5 miles south of, 0.20 mile north of **Dorcas School**, in northeast corner of bridge over small stream, in wooden support; copper nail, painted "1,025.7"	1,024.94
Petersburg, 4.9 miles south of, 100 feet north of **Dorcas Post-Office**, on west side of road, in south wall at southwest corner of Lutheran parsonage; bronze tablet stamped "W. Va. 1,067"	1,065.850
Dorcas, 1.0 mile south of, 80 feet north of **T** road east, 100 feet south of D. C. Mongold's residence, on east edge of road, in root of large tree; copper nail, painted "1,028.4"	1,027.64
Dorcas, 2.1 miles south of, 100 feet south of **Hedricks Chapel**, on east edge of road, in root of 10-inch pine tree; copper nail, painted "1,069.6"	1,068.77
Rough Run School, 0.7 mile north of, 50 feet south of Rough Run, opposite **T** road east, in root of large tree; copper nail, painted "1,111.1"	1,110.28
Rough Run School, at three corners, at southwest corner, in south foundation of Rough Run Schoolhouse; bronze tablet stamped "W. Va. 1,155"	1,154.655
Rough Run School, 0.9 mile southeast of, on second-class road, 500 feet south of old farm buildings, at top of small hill, on west edge of road, in large boulder; chiseled square, painted "1,366.3"	1,365.54

Feet.

Rough Run School, 1.7 miles southeast of, on second-class road at **T** road north, at northwest corner of bridge, in large boulder; chiseled square, painted "1,622.6" 1,621.82

Rough Run School, 2.5 miles southeast of, at three corners, in center of forks, 8 feet north of rail fence, in large boulder; bronze tablet stamped "W. Va. 1,992" 1,991.551

Rough Run School, 3.8 miles southeast of, at top of first mountain, on southwest edge of road, in root of locust tree; copper nail, painted "2,385.1" 2,384.33

Rough Run School, 4.7 miles southeast of, at bottom of ravine, 200 feet north of house, at sharp bend in road, in root of large oak tree; copper nail, painted "2,015.4" 2,014.60

Rough Run School, 5.5 miles south of, opposite second-class road to Isaac Simmon's residence, 8 feet west of road, in large boulder; bronze tablet stamped "W. Va. 2,291" 2,290.155

Wine Spring School, 2.1 miles northwest of, 0.65 mile south of Isaac Simmon's residence, on horseback trail, near head of ravine, 200 feet north of gate, in rock; chiseled square, painted "2,366.1" 2,365.28

Wine Spring School, 1.1 miles west of, on horesback trail, at northwest corner of old cabin, in small rock; chiseled square, painted "1,790.1" 1,789.26

Wine Spring School, 20 feet northwest of, in top of large rock; bronze tablet stamped "W. Va. 1,217" 1,216.150

Wine Spring School, 0.9 mile northeast of, in front of **Zion Church,** in root of hickory tree; copper nail, painted "1,191.7" 1,190.86

Wine Spring School, 1.9 miles northeast of, 0.45 mile south of **Peru,** near J. Dasher's residence, on south side of small stream, in root of large tree; copper nail, painted "1,155.1" 1,154.20

Peru, at northwest corner of flour-mill, in old millstone; bronze tablet stamped "W. Va. 1,136" 1,134.681

Peru, 1.3 miles northeast of, at **T** road west, on east edge of road, in large rock; chiseled square, painted "1,159.9" 1,158.99

Peru, 2.4 miles northeast of, in front of C. Cowger's residence, on west edge of road, in root of large tree; copper nail, painted "1,105.9" 1,104.98

Peru, 3.5 miles northeast of, at **Blue Rock School,** in east side at southeast corner, in stone foundation; bronze tablet stamped "W. Va. 1,064" 1,062.885

Peru, 4.6 miles northeast of, 40 feet south of **T** road west, 10 feet west of highway, in small rock; chiseled square, painted "1,044.9" 1,044.01

Peru, 5.7 miles northeast of, on west edge of road, in small rock, chiseled square, painted "1,033.7" 1,032.79

Peru, 6.9 miles northeast of, on South Fork (Moorefield) road, at field roads, 40 feet from main road, near field gate, in large boulder; bronze tablet stamped "W. Va. 992" 991.378

Peru, 7.8 miles northeast of, in front of and opposite S. Ray Our's residence, on west edge of road, in root of sycamore tree; copper nail, painted "996.9" 995.98

Peru, 9.0 miles northeast of, in front of G. V. Wolfe's store, at **Bass Post-Office,** 3 feet from northeast corner of wooden bridge over small stream, in root of maple tree; copper nail, painted "984.9" 983.92

From Rough Run southwest along highways to Kline Crossroads Millgap, thence west to west border of quadrangle.

(Line goes to Upper Tract, Onego Quadrangle).

	Feet.
Rough Run School, 1 mile south of, near old barn, 20 feet south of small bridge, on west edge of road, in root of walnut tree; copper nail, painted "1,187.5"	1,186.68
Rough Run School, 1.9 miles south of, at top of hill, on east edge of road, in root of old oak tree; copper nail, painted "1,263.3"	1,262.54
Rough Run School, 3.3 miles south of, in east foundation at northeast corner of **Judy School,** in stone; bronze tablet stamped "W. Va. 1,253"	1,252.645
Rough Run School, 4.1 miles south of, at top of small hill, on east edge of road, in large rock; chiseled square, painted "1,273.7"	1,272.86
Rough Run School, 5.2 miles south of, 0.25 mile north of sawmill, on west edge of road, in root of large oak tree; copper nail painted "1,374.9"	1,374.07
Rough Run School, 6.4 miles south of, in door-step to **Borror School,** in stone; bronze tablet stamped "W. Va. 1,453"	1,451.770
Kline, 3.6 miles north of, at top of small hill, on west edge of road, in root of large oak tree; copper nail, painted "1,494.7"	1,493.90
Kline, 2.5 miles north of, on west end of small wooden bridge in front of Isaac Harmon's residence; copper nail, painted "1,558.5"	1,557.66
Kline, 2.1 miles north of, at three corners, 80 feet west of forks, on south edge of **T** road, in large stone; bronze tablet stamped "W. Va. 1,576"	1,575.344
Kline, 1.1 miles north of, in front of A. O. Lough's residence, on east edge of road, in root of large walnut tree; copper nail, painted "1,591.5"	1,590.72
Kline, 100 feet northwest of post-office, on east edge of road, in large boulder; chiseled square, painted "1,616.8"	1,616.02
Upper Tract, 3.3 miles east of, at **Kline Crossroads,** on north edge of, 200 feet east of C. A. Mitchell's residence, in large rock; bronze tablet stamped "W. Va. 1,725"	1,724.528
Upper Tract, 2.7 miles east of, in front of **Schmucker School,** in triangle at three corners, in root of oak tree; copper nail, painted "1,586.9"	1,586.12

From Kline Crossroads south along highway to south border of quadrangle.

(Line enters Fort Seybert Quadrangle).

Upper Tract, 3.3 miles east of, at **Kline Crossroads,** on north edge of, 200 feet east of C. A. Mitchell's residence, in large rock; bronze tablet stamped "W. Va. 1,725"	1,724.528
Kline, 1.6 miles southeast of, at top of first hill on west edge of road, in root of small pine tree; copper nail, painted "2,188.7"	2,187.86
Kline, 2.6 miles southeast of, on west edge of road, on north edge of lane to Cook's farm, in root of gum tree; copper nail, painted "2,382.7"	2,381.84

From Peru along highways east to Virginia-West Virginia State Line thence southwest along same on ridge to point 3 miles south of Mount Pleasant School, thence west to Lick Run.

	Feet.
Peru, at northeast corner of flour-mill, in old millstone; chiseled square, painted "1,135.5"	1,134.60
Peru, 0.8 mile southeast of, in southeast corner of T road south, in root of 10-inch tree; copper nail, painted "1,225.7"	1,224.78
Peru, 2.2 miles southeast of, on Doveville road, 10 feet north of road, in root of 20-inch oak tree; copper nail painted "1,419.2"	1,418.32
Peru, 2.9 miles southeast of, on Doveville road, at north edge of road, in large boulder; bronze tablet stamped "W. Va. 1,636"	1,635.206
Peru, 3.9 miles southeast of, at point of mountain, on east edge of road, in ledge of rock; chiseled square, painted "2,012.6"	2,011.64
Peru, 4.9 miles southeast of, 0.6 mile west of the State Line, on northeast edge of road, in ledge of rock, chiseled square, painted "2,392.1"	2,391.18
Peru, 5.5 miles southeast of, on Virginia and West Virginia State Line, 100 feet south of road forks, in front of Silas Dove's residence, in large rock near oak tree; bronze tablet stamped "W. Va. 2,424"	2,423.094
Dove Triangulation Station, 1.8 miles north of, on Virginia and West Virginia State Line, at top of **Pine Knob,** 15 feet east of road, in root of oak tree; copper nail, painted "2,747.0"	2,746.03
Dove Triangulation Station, 0.8 mile east of, at east end of clearing, on south edge of road, in root of oak tree; copper nail, painted "2,841.1"	2,840.19
Dove Triangulation Station, 100 feet west of John Dove's barn, in small stone; bronze tablet stamped "W. Va. 3,010"	3,009.002
Mount Pleasant School, 100 feet west of schoolhouse, on Virginia-West Virginia State Line, in northeast corner of crossing, in root of oak tree; copper nail, painted "2,808.6"	2,807.66
Mount Pleasant School, 1.2 miles southwest of, on Virginia-West Virginia State Line, at driveway to Casper Turner's residence, in northeast corner of forks, in root of large oak tree; copper nail, painted "3,059.8"	3,058.85
Mount Pleasant School, 2.2 miles south of, on Virginia-West Virginia State Line, at sharp bend in road, opposite John Getz's residence, on east edge of road, in root of oak tree; copper nail, painted "3,016.4"	3,015.39
Mount Pleasant School, 3.0 miles south of, on West Virginia-Virginia State Line, at head of Camp Run, in northeast corner of cross-roads, 8 feet north of road, in large boulder; bronze tablet stamped "W. Va. 3,017"	3,015.545
Virginia-West Virginia State Line, 0.9 mile west of, on south edge of road, in root of apple tree, copper nail, painted "2,792.0"	2,791.07
Virginia-West Virginia State Line, 1.9 miles west of, at sharp bend in road, in south edge, in root of hickory tree; copper nail, painted "2,180.2"	2,179.25

	Feet.
South Fork road, at junction of Camp Run road, 60 feet south of forks, on east edge of road, in root of locust tree; copper nail, painted "1,427.0"	1,426.01

From Wine Spring School southwest along highways to south border of quadrangle. (Line enters Fort Seybert Quadrangle).

Primary leveling by Walter McCrea in 1919.

Wine Spring School, 20 feet northwest of, in top of large rock; bronze tablet stamped "1,217 W. Va."	1,216.150
Wine Spring School, 1.1 miles south of, in door-sill of George Dasher's cattle-scales, west side of road; copper nail and washer, painted "T. B. M. 1,283" on building	1,282.02
Wine Spring School, 2.1 miles south of, 1,500 feet north of B. Souder's gate to dwelling, east side of road, in root of maple tree; copper nail and washer, "T. B. M. 1,297" painted on tree	1,296.04
Wine Spring School, 3.3 miles south of, at Cyrus Mitchell's barnyard gate, west side of road, in small rock; bronze tablet stamped "1,344 W. Va."	1,343.308
Wine Spring School, 4.3 miles south of, 105 feet south of intersection of roads, 20 feet east of road, in root of locust tree; copper nail and washer, "T. B. M. 1427" painted on tree	1,426.01

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